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Multiple Switch-Boards for Telephone Communications.

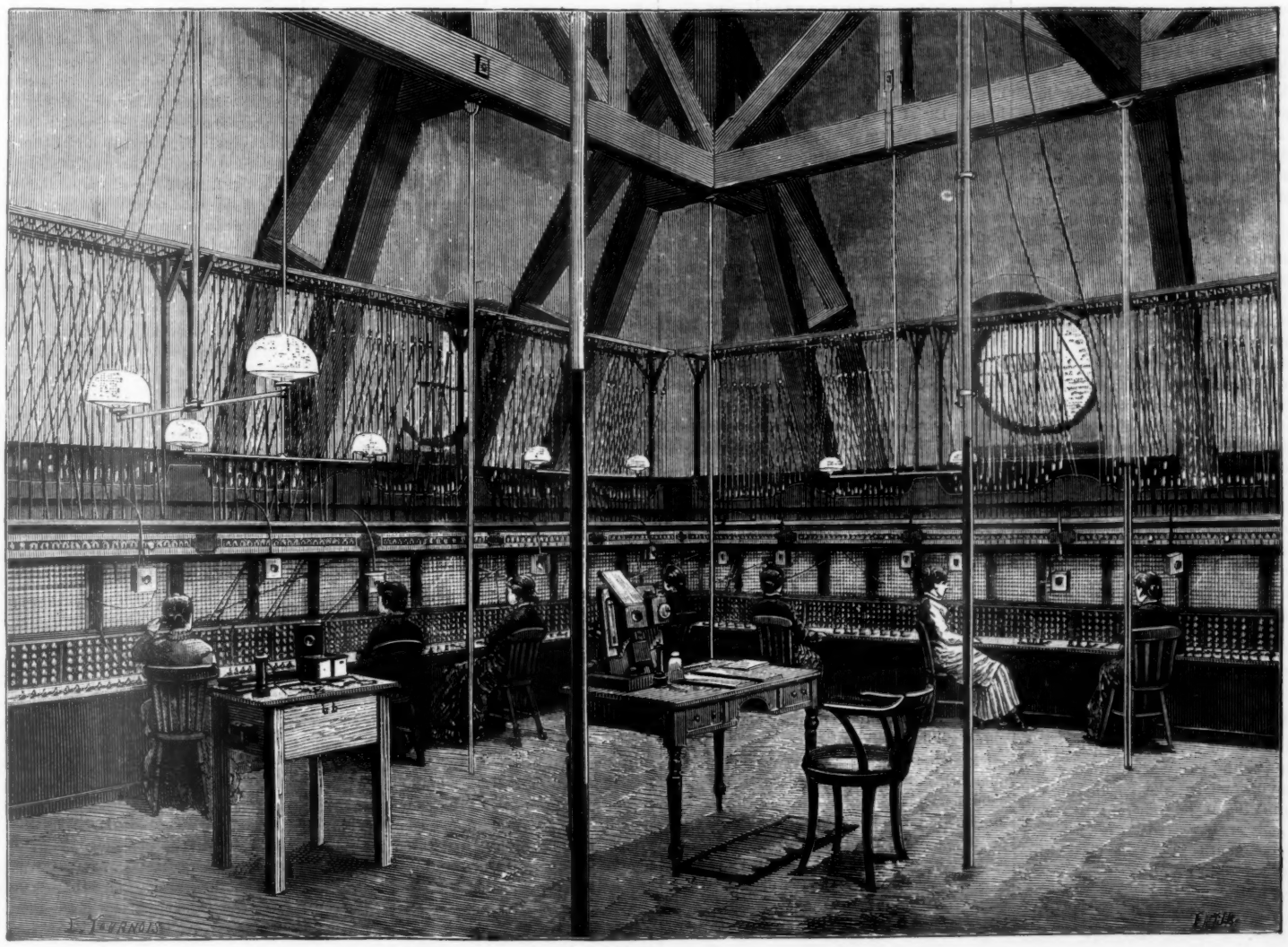
The desire, and even the necessity, which is always felt in America, of saving time, is constantly giving birth to new inventions, and it is in response to this want that a great number of telephone central offices in America have adopted a new system of switch-boards; one of which has also been recently installed in the telephone central office in Liverpool. The multiple switch-board in Liverpool has been put up to serve 1,000 subscribers, although provision can be made for 2,500. It is divided into five sections, each one of which is provided with 200 annunciators, and one thousand spring contact points, so that the operator in charge of one section, while receiving the calls of only 200 subscribers, can nevertheless without moving, connect together any two wires of the 1,000, and without the aid of either of the other operators. The connections are made by means of plugs and flexible cords, connected in circuit with a special annunciator, intended to receive the subscriber's signal indicating the close of the conversation.

Each subscriber is represented in one of the sections of the switch, by an annunciator, but before reaching the annunciator his wire passes through each section of the switch-board, where it is intercepted by a spring contact, in such a manner that each operator in the office can make communication with the wire. It is evident that if this wire remains always at the disposal of the operators, all of whom can use it for the purpose of making connection, and who have not the time to make sure by observation of all the sections of the system, whether the wire is in use or not, it becomes necessary to provide an easy method of indicating whether a certain wire is already in use in another section. This has been accomplished in a very simple manner, by means of a signal given at the moment when the connection is made, and which is heard in the telephone of the operator, at the instant the plug touches the spring contact of the subscriber. This signal indicates that the line is in use elsewhere and prevents the operator from completing the connection.

In order to obtain this signal, and in order that all the lines of the system may be at the disposal of all of the operators at the same time, it is necessary that each wire should pass through each section of the switch twice. The communicating wires pass in a cable behind the switch, and in an important office their number is necessarily enormous. All of the apparatus with its numerous connections is naturally very complicated and demands great skill and care in the putting up.

At the same time, although simplicity of construction may be important in an apparatus which must be placed in the hands of subscribers, simplicity of manipulation is not the most important point in an apparatus placed in a central office. A simple construction may there cause practical complications, whilst a complicated construction offers fewer inconveniences, as long as it permits of a simple manipulation. Although of a complicated construction, the multiple switch-board nevertheless fills a great want in a central office system by allowing rapid and sure connections, and by economizing the work of the hands. To demonstrate the economy of time secured by this system, it suffices to describe the old method, which consisted of dividing the subscribers between different boards, each of which generally contained 50, with a certain number of communicating bands or wires between them. Each board was served by a special operator.

The intervention of two operators was then necessary to make one connection; the first received the call of the subscriber, and connected his wire to a communicating band, and the second connected that band with the wire asked for at the other switch-board; the order to make the connection having been transmitted from the first to the second employe verbally, or by means of a written slip. The first method gave rise to a good deal of noise and confusion, whilst the slip caused delays, errors were frequent, and the result was naturally irritating to the subscriber who was awaiting his connection during all of that time. The multiple system permits each employe to control all of the wires, and reduces by one-half the labor necessary to make the connection; no word is spoken, no slip is written, and the intervention of but one person is required. Our illustration represents nearly the whole of the switch-board, of which only a small part



THE MULTIPLE SWITCH BOARD IN THE CENTRAL TELEPHONE EXCHANGE, LIVERPOOL, ENGLAND.

of each side is wanting. The sections now in place form the two sides of a square, to which will be added other sections of 200 subscribers from time to time, in proportion as the number of subscribers increases. As soon as the new sections are put in place, other spring-contacts will be installed in the existing boards, in the places which have been left vacant for them. Besides, the frame which contains the special annunciators is movable and can be raised up higher to allow space for the spring contacts, if necessary. The system is thus arranged with a capacity for progressive development which may be extended to 2,500 subscribers. The spring contacts are mounted in groups of 100, on a wooden back of about 12 inches by 5 inches, and 25 annunciators occupy a space of about 9 inches by 7 inches. Each section of the Liverpool switch then measures about 7 feet long. The switch-board is placed at a height of about 23 inches above the floor, so as to place all portions within the reach of an employe.

The length of each section allows enough space for the employes to work easily and permits, if necessary, the placing of three before each section, although in general two are amply sufficient for each 200 wires. The system is thus arranged to provide for all emergencies, and it is, at the present time, employed in a large system (that of Indianapolis with 1,200 subscribers) where the number of calls per day attain to 10 per subscriber.

The number of employes has already been reduced in Liverpool and the present staff will not be increased until many new subscribers have been connected. We have been assured that the average time necessary to make a connection is 14 seconds, which are occupied as follows: The call is answered in 5 seconds, the operator calls the subscriber wanted and makes the connection in 9 seconds; or 14 seconds in all from the time the first subscriber sends his signal. The average number of daily calls in Liverpool is 6 per subscriber, so that with 900 subscribers there are about 5,400 telephonic conversations per day. As all of these 900 subscribers are connected with one single central office, this figure does not represent two or three times the number of conversations, as is the case in some systems where the subscribers are divided among several small auxiliary offices, and where all the calls are counted, although two or three are often necessary for a single conversation.

Outside of Liverpool, two other systems in Europe have adopted this system, those of Buda-Pesth and Guttenberg. In Melbourne the system has also been working for some time, and in America about twenty of the largest systems use it.—*La Lumiere Electrique.*

The Use of Secondary Batteries in Telegraphy.*

By W. H. Preece, F.R.S.

About the middle of last year a series of experiments with secondary batteries was commenced on some of the telegraphic circuits, terminating at the General Post Office, London, and their satisfactory behavior during twelve months' trial leads me to bring this subject before this section.

Dynamo-electric machines are regularly employed for signaling purposes in the United States. I think, therefore, before detailing the results of the experiments with secondary batteries in England it would be advisable to mention the experiments made with such machines there also. So long ago as the year 1865 the late Mr. Cromwell Varley tried a Wildes machine on several circuits at the electric and International Telegraph Company's station in Telegraph Street, London. About 1870 the Lancashire and Yorkshire Railway Company used one at Manchester. In 1872 Mr. Culley experimented with a Gramme magneto machine on several Post Office lines of moderate length. It was found, however, that the trouble arose from the great variations in the strength of the current due to variations in speed, from the rapid corrosion of the contact points in the instruments, and from the intermittent disconnections at the machine. These disconnections were apt to cause serious errors in a message by changing the character under transmission, or at least to produce loss of time by creating repetition.

The improvements made in dynamo machines since 1872 would doubtless overcome these difficulties, but no advantage would be gained by using them for the English system of telegraphy, for it would be difficult to obtain suitable changes of potential, or to adjust the dynamic effects of the very numerous classes of lines radiating from the machine. England, unlike America, is subject to frequent meteorological variations, and the majority of its telegraphic circuits are always liable to a transformation from simplex to a complex systems of signaling, or *vice versa;* moreover the double-current open circuit system being in use throughout Great Britain, uniformity of current is absolutely essential, especially where automatic working is in use. Rapid reversals of equal strength cannot be insured from dynamo machines.

In 1879, Mr. Louis Schwendler, the late electrician of the Indian Government, communicated to the *Philosophical Magazine* an interesting account of some experiments he had made with a dynamo electric machine for signaling purposes, while the dynamo was simultaneously working a powerful electric light. The telegraphic circuits were applied as a leak to the main lamp circuit, and it was apparently found that the small signaling currents tapped off did not produce any perceptible variation of the electric light. He therefore suggested that if the main current from the dynamo could be employed for electric lighting, or other useful work, which would repay the expense of the erection and working of the dynamo electric machine, the signaling currents would cost nothing. This, of course, assumed that the electric light machine was always running.

In telegraphy exceedingly weak currents produce the desired signals. These currents are expressed in milliamperes (the thousandths of an ampere), and can conveniently be obtained from a battery at pleasure. Furthermore, the number of independent units into which a battery of even moderate size can be subdivided is a very weighty advantage of which a dynamo-electric machine is wholly void. Now, if dynamo-electric machines were substituted for batteries at convenient English offices, there would still be a very large percentage of batteries required. The Postal telegraph depot had in use last year 129,789 cells of the bichromate, Daniell and Leclanche type. And if at the seven principal centers where steam engines are working for the pneumatic system all the cells (amounting, approximately, to 38,773), were replaced by dynamos, we should still have 70 per cent. more batteries than those replaced, for which dynamo-electric machines could not be substituted.

I will consider the London central station alone, as it contains about six times more cells than either of the other six offices. In March of the current year there was a total of 687 circuits, radiating from the chief offices through England, Ireland, Scotland, and Wales; and the various classes of circuits require different strength of current ranging from 14 to 80 milliamperes. The full current for all the circuits, viz., 20 amperes, has been approximately determined by adding together the currents necessary for each kind of instrument. The total battery power for these circuits was about 20,000 cells, which implies an approximate electromotive force of 28,000 volts, or an average of 40.75 volts per circuit. From this data we find that the total electric energy for all the circuits would be

$$\left(\frac{28,000}{687}\times 20\right)=815 \text{ watts},$$

or 1.09 horse-power, which would equal 0.0016 of a horse-power nearly for each circuit.

The total number of circuits include 290 distinct sets of special apparatus like those aforementioned, and employ 7,956 cells, or an average electromotive force of 11,112 volts. The output of current for these circuits is estimated at 6 amperes, therefore the energy expended equals

$$\left(\frac{11,112}{290}\times 6\right)=230 \text{ watts},$$

which are equal to 0.3081 horse-power. After deducting this from the total horse-power, 1.09, we have left 0.782 as that which might be developed by aid of a dynamo-electric machine in place of batteries. But this small amount of energy represents 397 circuits, which must be divided into groups of, say, 40 circuits, to facilitate expeditious removal of faults, as well as to reduce the number of lines subject to stoppage by a fault occurring on either branch within rea sonable limits. We should then have to provide eleven dynamo-electric machines, ten for the actual work and one for reserve, for we must endeavor to avoid a long cessation of telegraphic transmission. Suppose the 40 circuits grouped on one dynamo demanded an electromotive force of 40 volts, and a flow of one ampere current from the generator, when all were working simultaneously the maximum horse-power would be 0.053, as compared with the minimum, 0.0013, horse power required for a single circuit, showing a variation between .0013 and .053 of a horse-power.

We clearly have an exceedingly small expenditure of electrical energy for a dynamo to develop in compensation for the constant consumption of coal, wear and tear of engine, etc., and incessant attention required Calculation, however, brings out the annual cost of maintenance of dynamos considerably below the annual cost of maintenance for voltaic cells. We find the mean cost per cell per annum to be 2s., which, for 12,044 cells (the number we assumed to be replaced in the London Post Office by dynamo-electric machines) amounts to £1,204 8s. a year. Now, suppose the dynamos had a commercial efficiency of 80 per cent., the mechanical energy necessary to produce 0.782 of a horse-power, as electrical energy would be 0.977, or say one horse-power, and as horse-power requires about 4½ pounds of coal for its production, the cost of coal at 20s. a ton for twelve months' running of dynamos, averaging 18 hours a day, would be £14 16s., the annual cost may be specified thus:

Wages of four men at 25s. a week.	£260	0	0
Four per cent. interest on the plant valued at £1,300.....	52	0	0
Depreciation at 10 per cent.....	130	0	0
Coal at 20s. a ton.....	14	16	0
Waste and oil	10	0	0
	£466	16	0

which shows a balance of £737 12s. in favor of dynamo-electric machines. Nevertheless, there would be a decided disadvantage in using them, not only for the reasons already assigned, but also in the event of fire, when we could not so quickly or so aptly restore communication as with batteries. In the latter, batteries could be easily applied to the respective circuits at the nearest point of safety, whereas engines or dynamos would introduce many difficulties, and cause much loss of time. Finally, it should be remembered that the cost of batteries is so small an item in the general maintenance of the entire system of telegraphy that its consideration may be ignored. It is a question of efficiency and not of economy that will determine their use,

The first experiment with secondary batteries was that of eight so-called half horse-power Faure-Sellon-Volckmar cells, working a universal circuit system consisting of 31 distinct and separate circuits. These worked continuously for seven weeks without the slightest hitch or attention. Then came eight of Mr. Tribe's secondary cells, which were put on a similar universal set of 30 circuits, and worked it successfully for 52 days 2 hours. When exhausted the cells were joined to a dynamo, and a current of three amperes passed through them for 48 consecutive hours, no attendance beyond a casual glance being required. They were again started on the same circuit and lasted 58 days; a third similar charge was given them, and the circuit worked efficiently for another seven weeks. Their behavior was so good that we had no occasion even to look at them until a day or two before exhaustion. With two of the same kind of cells, a local sounder circuit, requiring five of our largest Daniells, was successfully worked without any attention for eight weeks. A further and very valuable experiment was also made with twelve Faure-Sellon-Volckmar cells on a universal set consisting of fifteen circuits, which terminated after fifteen weeks, or, excluding Sundays, ninety-two days' work. These were replaced by fifteen double fluid bichromate cells of quart size, and instructions given to carefully note the quantity of material used and time of attention bestowed upon them during the same period of action, viz., fifteen weeks. The particulars of this comparative test were as follows:

The secondary battery worked ninety-two days, averaging twelve hours a day, and the mean current was 0.5 of an ampere per hour, which six ampere-hours = a day, 552 ampere-hours for the whole time.

From what has been stated it will be evident that soon secondary batteries will be made the most economical of the three classes of generators considered. In them there is no waste nor trouble due to diffusion of liquids, as in primary batteries, while they possess all the features necessary for the requirements of the service of large offices. Even while they are being recharged, it would be possible for the circuits to work from the batteries simultaneously.

The only caution we have to exercise is that of preventing the current, in case of a short circuit accidentally occurring from fusing parts of the instruments, or injuring by heat the gutta-percha insulation of the leading wires, which run together in large numbers from the battery room to the instrument room. This we can do by constructing the secondary cells with a suitable resistance.

Lastly, it is worthy of notice that a charge of acid does not want renewing. All that is necessary is simply to recharge them electrically.—*London Electrician.*

*A paper read at the British Association Meeting, Montreal.

The population of the United States on July 1, said the New York *Tribune*, some weeks since, would be about 57,000,000. This is ascertained in the following manner: For many years the increase in time of peace has been almost precisely 2 per cent. yearly from excess of births over deaths besides the excess of immigration over emigration. The population June 30, 1880, was 50,115,783; adding 2 per cent. increase, 1,003,115, and the net immigration of the fiscal 1881, 669,431, we have 51,838,329 as the population June 20, 1881. Again adding 2 per cent., 1,036,566 and the net immigration, 788,992, we have 53,653,887 as the population June 30, 1882. Again adding 2 per cent, 1,073,087, and the net immigration 599,015, we have 55,325,979 as the population June 30, 1883. And again adding 2 per cent. for the current year, 1,106,519, and about 550,000 for immigration—the number during the fiscal year up to June 1 having been 454,206—we have as the probable population June 30, 1884, about 56,982,498. In two years more it will probably exceed 60,000,000.

Weight per Mile Ohm.

This term is to be understood as distinguishing the *resistance of material* only, and means the weight of such material required per mile to give the resistance of one ohm. To ascertain the mileage resistance of any wire, divide the "weight per mile ohm" by the weight of the wire per mile. Thus in a grade of Extra Best Best, of which the weight per mile ohm is given at the average of 4.800, the mileage resistance of No. 4 (weight per mile 707 pounds) would be about six ohms, and No. 14 steel wire, 6,600 pounds, weight per mile ohm (89 pounds weight per mile) would show about 75 ohms.

The growth of manufactures of the United States since 1850 is thus given by Mulhall's Dictionary of Statistics: Value of American manufactures in 1850, $1,060,000,000; in 1860, $1,970,000,000; in 1870, $4,230,000,000 in 1880, $5,560,000,000. In 1860 the value of manufactures per inhabitant was $61.75; in 1880, $110. In 1850 the

number of persons employed in manufactures of all kinds was 957,000; in 1860, 1,311,000; in 1870, 2,054,000; in 1880, 2,739,000. In 1850 the wages paid were $245,000,000; in 1860, $400,000,000; in 1870, $805,000,000, in 1880, $990,000,000. In 1850, the capital invested in manufactures was $550,000,000; in 1860, $1,040,000,000; in 1870, $2,205,000,000; in 1880, $2,405,000,000. These statistics are taken from the census reports, and are approximately correct.

Secondary Battery.

It is known that it is necessary to often renew the electrolytic fluid in secondary batteries, on the one hand because of the electrolysis which is produced during the charging of the elements, and on the other hand in consequence of its continued evaporation. The disengagement of noxious vapors provoked by electrolysis and evaporation, as well as the pollution of the atmosphere in habitations, which is the consequence, have given rise to a great number of experiments tending to remedy that state of things.

It is for the purpose of avoiding the inconveniences which were just mentioned that Mr. Eli Starr has constructed a new secondary battery. Mr. Starr proposes to convey the electrolytic liquid—dilute sulphuric acid, for instance—to the secondary batteries by conduits, and to renew it when required in proportion as the batteries become exhausted, by electrolysis and by evaporation, when they are used in a system of electric lighting or the distribution of force from a central station.

Fig. 1 shows the battery in position for use. In the cellar is placed a cupboard, which incloses a secondary battery of a force sufficient to feed the lamps of the house in which it is placed. The door *A* is provided with a strong lock. *B B* represents the cells of the battery mounted on the shelf A_2; *c* is a faucet in the caoutchouc tube *k*. On the lid of the cupboard is represented a reservoir containing the diluted liquid.

When it becomes necessary to furnish the electrolytic liquid to the cells of the battery, the valve *G* raises automatically, and the liquid enters the compartment *E* and passes from there into the cells of the battery. In order to secure the automatic renewal of the liquid, the valve is attached by means of a rigid arm to one of the extremities of a balance, *f*, which carries an armature, *C*, at its other extremity (see Fig. 2 for details). *I* represents a rod disposed so as to pass across the top of the box, and carrying on its extremity a float which follows the variations in the level of the liquid in the compartment *E;* when this level falls too low in the cells the float descends, and thus brings the insulated superior extremity of the rod *I* in position to close the local circuit 1, 2.

In this circuit is placed the electro-magnet *H*, which attracts the balance, the effect of which is to open the admission valve (Fig. 2) The inverse operation naturally takes place when the level of the liquid rises. *L* represents a reservoir, in which the gases disengaged by electrolysis or evaporation of the liquid can be gathered to be utilized later. Instead of leading to the reservoir, the pipe *k* can end outside of the house, in such a manner as will prevent injurious effects from the disengagement of vapors.—*Ex.*

What is Electricity?

Professor Trowbridge, in his address before the American Association for the Advancement of Science, said that all he hoped to do was to make his audience ask themselves the question with more humility and a greater consciousness of ignorance. "We shall probably never know what electricity is, any more than we shall know what energy is. What we shall be able, probably, to discover is the relationship between electricity, magnetism, light, heat, gravitation, and the attracting force which manifests itself in chemical changes. Fifty years ago scientific men attached a force to every phenomenon of nature; thus there were the forces of electricity and magnetism, the vital forces and the chemical forces. Now we have become so far unitarian in our scientific views that we accept treatises on mechanics which have the one word "Dynamik" for a title; and we look for a treatise on physics which shall be entitled "Mechanical Philosophy," in which all the phenomena of radiant energy, together with the phenomena of energy which we entitle electricity and magnetism, shall be discussed from the point of view of mechanics. What we are to have in the future is a treatise which will show the mechanical relation of gravitation, of so-called chemical attracting force and electrical attracting force, and the manifestations of what we call radiant energy. We have reduced our knowledge of electricity and magnetism to what may be called a mechanical system, so that in a large number of cases we can calculate beforehand what will take place, and we are under no necessity of trying actual experiments. It is probable, for instance, that the correct form of a dynamo machine for providing the electric light can be calculated and the plans drawn with as much certainty as the diagrams of a steam engine are constructed. We may congratulate ourselves, therefore, in having a large amount of systematic knowledge in electricity; and we see clearly how to increase this systematic knowledge, for we have discovered that a man cannot expect to master the subject of electricity who has not made himself familiar with thermo-dynamics, with analytical mechanics, and with all the topics now embraced under the comprehensive title of "Physics."

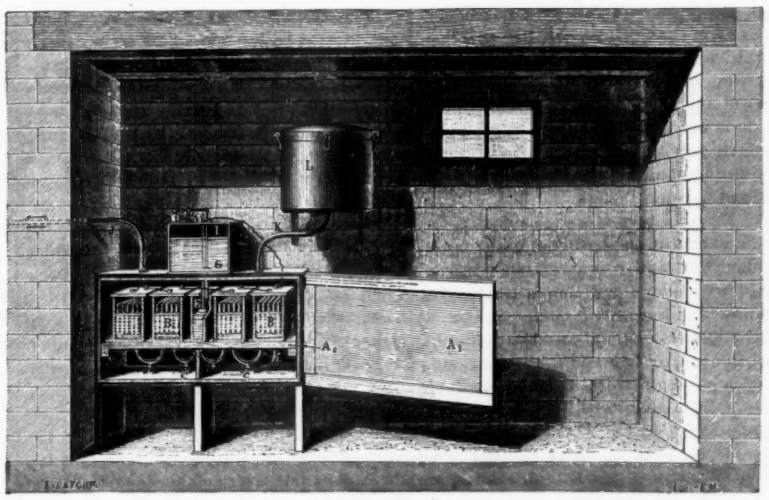


FIG. 1.—SECONDARY BATTERY.

Out of all the theories of electricity, the two-fluid theories, the one-fluid, or Franklin theory, and the various molecular theories, not one remains to-day under the guidance of which we are ready to march onward. We have discovered that we cannot speak of the velocity of electricity. All that we can truly say is, we have a healthy distrust of our theories, and an abiding faith in the doctrine of the conservation of energy.

It is one thing to become familiar with all the applications of the mechanical theory of electricity, and another to make an advance in the subject so that we can see the relations of electric and magnetic attraction to the attraction of gravitation, and to what we call chemical attraction. The new advances in our knowledge of electrical manifestations are to come from the true conception of the universality of electrical manifestations, and from the advance in the study of molecular physics. When we let an acid fall from the surface of a metal, the metal takes one state of electrification and the drop of acid the other; in other words, we produce a difference of electrical potential. On the other hand, a difference of electrical potential modifies the aggregation of molecules. The experiments of Lippman are well known. He has constructed an electrometer, and even a dynamo electric machine, which depend upon the principle that the superficial energy of a surface of mercury, covered with acidulated water, is modified when a difference of electrical potential is produced at the limiting surfaces. The manifestations of what is called superficial energy—that is, the energy manifested at the surface of separation of any two substances—and the effect of electricity upon the superficial energy, afford much food for thought. There have always been two parties in electricity—one which maintains that electricity is due to the contact of dissimilar substances, and the other party which believes that the source of electrical action must be sought in chemical action. Thus, according to one party, the action of an ordinary voltaic cell is due to the contact, for instance, of zinc with copper, the acid or solution of the cell merely acting as the connecting link between the two. According to the other party, it is to the difference of the chemical action of the metals on the connecting liquid that we must attribute the rise and continuance of the electrical current. The electromotive force of a voltaic cell is undoubtedly due to the intrinsic superficial manifestation of energy, when two dissimilar metals are placed in connection with each other either directly or through the medium of a conducting liquid. The chemical action of the liquid brings new surfaces of the metals constantly in contact; moreover, we have the difference of superficial energy between the liquid and the metals, so that our expression for electromotive force is far from being a simple one; it contains the sum of several modifications of superficial energy at the surfaces of the two metals, and at the two boundaries of the liquid and the metals.

We have again a development of electromotive force by the mere contact of the metals at different temperatures. The electrical current that arises is due to the difference of superficial energy manifested at the surface of the two junctions. We know that the action is on the surface, for the size of the junctions does not affect the electromotive force. Suppose that we should make the metals so thin that an ultimate molecule of iron should rest against an ultimate molecule of copper, should we not arrive at a limit, at a definite temperature of the conversion of molecular vibration into electrical energy? And also, when our theory is perfected of the number of molecules along a lineal line of copper against a linear line of zinc which can produce a current of electricity of a given strength—the jostling, so to speak, of these ultimate molecules of two metals at different temperatures might form a scientific unit of electromotive force in the future science of physical chemistry. By means of an alloy we can apparently modify the superficial energy at the surface of a solid. Thus an alloy with a parent metal will give a varying electromotive force. If we could be sure that an alloy was always of a definite chemical composition, and not a more or less mechanical admixture, it seems as if we could get closer to the seat of electromotive force by a number of quantitative measurements. Unfortunately, the physical nature of alloys is not definitely known, and there is little coherence or regularity in our measurements of their electromotive force. We can modify the superficial energy of metals, not only by melting metals together, but also by grinding them to a very fine powder, and compressing them again by powerful means into solids more or less elastic, and then examining their superficial energy, which is manifested as electromotive force. Professor Trowbridge is still engaged upon researches of this nature; and, if the work is not brilliant, he hopes that it will result in the accumulation of data for future generalization.

The subject of thermo-electricity has been eclipsed by the magnificent development of the dynamo-electric machines; but we may return to thermo-electricity as a practical source of electricity. Professor Trowbridge has been lately occupied in endeavoring to modify the difference of potential of thermo-electric junctions by raising one junction to a very high temperature under great pressure; for it is well known that the melting point of metals is raised by great pressure. If the metal still remains in the solid state under great temperature and great pressure, can we not greatly increase the electromotive force which results from the difference of superficial energy manifested at the two junctions?

It is evident that our knowledge of electricity will increase with our knowledge of molecular action, and our knowledge of molecular action with that which we call attractive force. It is somewhat strange, that, although we are so curious in regard to electricity, we seldom reflect that gravitation is as great a mystery as electrical attraction. What is the relation between electricity and magnetism and gravitation and what we call the chemical force of attraction?

Professor Trowbridge ventured to state an hypothetical law which it seemed to him is at least plausible: That "whenever the force of attraction between the masses or molecules is modified in any way, a difference of electrical potential results." Is it not reasonable to suppose that certain anomalies which we now find in the determinations of specific heats of complicated aggregation of molecules are due to our failure to estimate the electrical equivalent of the movements and interchanges of the molecules? Let us take the case of friction between two pieces of wood; is it not possible that the friction is the electrical attraction which results from the endeavor to connect the phenomenon of superficial energy with electrical manifestions, that the friction between two surfaces is modified by keeping these surfaces at a difference of electrical potential? In Edison's motophone, we see this exemplified in a very striking manner.

Professor Trowbridge's own studies have been chiefly in the direction of thermo-electricity and in the subject of the electrical aspect of what we call superficial energy. These experiments so far deepen the belief that any change in the state of aggregation of particles—in other words, any change which results in a modification of attracting force—whether gravitative or the commonly called chemical attracting forces, results in an electrical potential; and conversely, that the passage of electricity through any medium produces a change of aggregation of the molecules and atoms. If we suppose that radiant energy is electro-magnetic, cannot we suppose that it is absorbed more readily by some bodies than by others, or, in other words, that its energy is transferred, so that with the proper sense we would perceive what might be called electrical color, or, in other words, have an evidence of transformations of radiant energy other than that which appeals to us as light and color? We have arrived at the point in our study of electricity where our instruments are too coarse to enable us to extend our investigations. Is not the physicist of the future to have instruments delicate enough to measure the heat equivalent of the red and the yellow and the blue violet rays of energy? instruments delicate enough to discover beats of light as we now discover those of sound? The photographer of to-day speaks in common language of handicapping molecules by mixing gums with his bromide of silver, in order that their rate of vibration may be affected by the long waves of energy. Shall we not have the means of obtaining the mechanical equivalent of such handicapped vibrations? We have advanced; but we have not answered the question which filled the mind of Franklin, and which fills men's to-day: What is electricity?

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It is whispered that while the owners of the Bennett-Mackay cable will nominally hold the same rates as the other transatlantic cable companies, they will bid for patronage by offering a rebate to large customers. This will, without doubt, bring about a cable war, which will certainly be enjoyed by the spectators and those who make frequent use of ocean telegraphy. If such war might bring about a permanent reduction of the present enormous tolls, and bring an Atlantic cable within the reach of men of ordinary fortune, it will not have been in vain.

The managers of the American Electrical Exhibition at Boston have done quiet but very effective work in the last few weeks, and will surprise the public with the immense number of novel and entertaining exhibits electricity can produce. The fact that they will not charge for power nor floor space, a charge that was quite high at Philadelphia, has made them the recipients of many applications from parties who have not exhibited anywhere before, and as the development in the electrical science is very rapid, many things will be shown here that the public has never seen. The number of arc light systems will be shown by eleven, and the modes of incandescent lighting by thirteen, companies.

The question is often asked why is it that all the different incandescent systems flourish side by side, unmolested by one another, when, to the ordinary observer, they are so closely alike in form and construction as to afford the very best possible chance for litigation. The fact is that the lamps which give light through the medium of the incandescence of a carbon filament in a vacuum are, in this respect, all alike, and this is certainly a very important respect, but in others, notably in methods of construction and in connecting and other devices, they differ widely. If any one has a "broad claim" on the use of a filament raised by electricity to incandescence in a vacuum as a source of light, he has thus far failed to make it good before the courts, and it is a pretty poor electrical establishment that does not make incandescent lamps on its own account, if only for the fun of the thing. But they say that there is to be an end to all this, and that we are soon to see the liveliest kind of litigation in this matter. There will be a good deal of curiosity to see the different claims that are set up.

ARC LIGHTING AS A BUSINESS.

One would suppose, to judge by much of the current talk, that arc lighting as a business was practically a failure, that it could not be made to pay, and that the extinguishment of existing arc lights throughout the length and breadth of this land was merely a question of time. Of course, it is true that, as a rule, popular opinion is based on insufficient data, and that it is safer generally, in a matter of this kind, to assume that popular opinion is wrong than that it is right; but it is, nevertheless, a duty to at least try to give such information as may help to set it right, futile and hopeless though the task appears to be. We have been at some pains to ascertain the extent of the business of the different manufacturing companies making and selling arc lamps and the accompanying dynamos in this country, and find that, at the very lowest computation, their joint output exceeds three thousand lamps per month, say, to be *very* safe, thirty five thousand per annum. More than this, we find that all the important ones are working up to their full capacity, some of them running their machinery overtime, and that all of them are taxed to their full capacity to supply the demands made upon them. More than this, the fact is disclosed that the demand is steadily increasing. Now, if it be true, as alleged, that arc lighting is a failure, and that it is going out of existence because it is unremunerative and unsatisfactory, why are all these lamps ordered, where do they go to, and who pays for them? Why is it that a very large proportion of the orders come from companies already established and doing business, for the extension and increase of their plant, in order, as they say, to meet the demands made upon them for more lights? Surely they have no motive for deception in this matter, and none for putting out their money for additional apparatus unless, as a matter of business, it pays them to do so. No; the fact is that, in this matter, as in most matters which it investigates only superficially, the public is wrong, and the *dicta* of interested parties who thought they saw a powerful rival in the arc light, although they now acknowledge it as an ally and friend, have had a very large part in making it wrong, and, by persistent misrepresentation, keeping it wrong.

We have been privileged to know something of the inside of the business of quite a number of electric lighting companies using arc lights, and we state a fact within our knowledge when we say that a very great many of them are doing well, earning substantial dividends, and laying something aside as well; and we can also say that, if the result has been less satisfactory in some cases, the blame is not to be laid at the door of the arc light *per se*. Its use is increasing and extending, it is operated at a constantly decreasing expense, it is steadily improving in quality, *and it has come to stay.*

CONCERNING TELEPHONE OPERATORS.

The reference made in the letter from our Buffalo correspondent last week to the course pursued by the local Western Union management in recruiting the force of operators, which, owing to the very rapid growth of business, is very fast increasing, is well worthy the attentive consideration of all telephone exchange managers as well as those having charge of telegraph offices.

You cannot make intelligent operators out of poor material. Intelligent service is the first requisite of success, and to have it you have got to have operators who possess a fair amount of education and minds naturally quick and active. The good of the service should be the first and only thing considered, and the sisters, cousins, aunts and friends of officers, stockholders and employes should be given no preference because of their "influence" or that of their backers and friends, for "influence" is as destructive of good service in a telephone exchange as in a government bureau. Positions as telephone operators are desirable. The work is by no means difficult or exhausting, the surroundings are unexceptionable in every way, and the pay is fully up to the average of what is paid to female employes. Therefore telephone companies, if they will but take the pains to seek and find it, can have their pick of the very best material—material out of which the best operators can, in time, be made.

Good, intelligent operating means prompt service and satisfaction to subscribers, and it also means a larger amount of service daily per operator employed. It is not for us to undertake to say just what steps shall be taken to secure such operators as are desired, but a glance through the letter of our Buffalo correspondent will afford some hints. Apply to the principal of the local High School and intimate that, at the end of the school year, there will be an opening for a certain number of beginners Get his idea first as to which members of his class would be likely to desire such a chance. Then, out of these names select, on the basis of education and general intelligence, the requisite number. A good hand-writing ought to be insisted upon. So ought such a knowledge of the English language as insures ability to write a good, well-expressed letter off-hand. The more general knowledge the applicant has the better; but, over and above all the qualities that a competitive examination will disclose, there is a certain natural brightness and quickness of mental action which impresses itself upon you at once. If the sisters, cousins, and aunts of the parties aforesaid have all these qualities, and the other candidates have them not, employ the former; but if you can find the requisite mental endowments without invading the home circles of your officers, stockholders, or employes, by all means do so.

One thing more. Have graded rates of salary. Begin small, and work up gradually, not in accordance with length of service wholly, although that is an element to be considered, but efficiency of service should have first place. Operators should be made to feel that there is room at the top for them as well as for other people. Let us suppose a case. An exchange has twelve operators, who receive average pay, say $25 a month each. They are fairly good operators, and that is all. Now, suppose it should come to pass that, by having more intelligent operators, operators of quicker apprehension and closer application, ten operators could do the same amount of work with equal or greater satisfaction. Clearly there is a saving of two operators. Would this mean a saving of the pay of two operators? No, it would not, and it should not. At least a share of the advantage resulting from more intelligent service belongs, in justice, to the operators. Suppose the company go them halves; that is of the fifty dollars, suppose twenty-five be added to the salaries of the remaining ten, giving each two dollars a half a month additional, and that the other twenty-five be saved to the company's treasury.

This is a theoretic case, of course, and could hardly occur in actual practice, but the *idea* is there, and is well worth studying. The principle is to insist on the very best service, to employ only those who can give it, and to make it an object for them to give it, partly as a matter of practice, but chiefly because it will pay.

The following circular, which seems to cover the substantial facts governing the present business in the telephone field, has just been published by the Southern Bell Telephone and Telegraph Company, through their Superintendent at Birmingham, Ala.:

THE TELEPHONE.

"It is due not only to our own business interests but to our patrons and the public generally, that we give as full information as possible in regard to the status of the Southern Bell Telephone and Telegraph Company, and its attitude towards the infringing telephone companies now seeking attention, particularly the so-called 'Pan-Electric' enterprise which is soliciting capital in the cities of Alabama. With these facts no one need be imposed upon or invest money under misapprehension.

"The telephone, invented by Prof. Bell, has been in public use for eight years. During that time there have been numerous infringements, which have been the subject of litigation, but every decision of the courts has been in Bell's favor. Mr. Justice Gray, of the Supreme Court of the United States, and Judge Lowell, in their decisions, state that 'Bell discovered a new art—that of transmitting speech by electricity,' and 'that he has a right to hold the broadest claim for which it can be permitted in any case—that his patent is not limited to a particular form of apparatus, but includes the process or method of producing undulatory vibrations of electricity to correspond with those of the air, and transmitting them to a receiving instrument capable of echoing them.'

"We shall be pleased to furnish copies of these decisions.

"The earliest and most formidable opponent of the legitimate telephone interests was the Western Union Telegraph Company. Suits were brought against the agents of that company several years ago, and after the taking of evidence proving Mr. Bell's invention of the telephone beyond a doubt, the Western Union transferred all its patents to the American Bell Telephone Company and retired from the business.

"Since then suits have been repeatedly brought against other infringers, and injunctions have invariably been obtained, with one exception, which was in a suit brought by the American Bell Company against the 'Overland' telephone infringers in Philadelphia early in the present year. The case of the defendants, in attempting to prove that their instruments were not infringements, was torn to pieces; but conscious of the fatal weakness of their defence, they introduced the evidence taken in the Drawbaugh case, and on this account the court deferred its decision until that case had been heard and determined.

"The Drawbaugh case here referred to turns upon the question of priority of invention. Drawbaugh claims that he had invented the telephone, with Bell's, Edison's, Blake's and other improvements, years before these scientists brought them out! He did not apply for a patent, however, until four years after Bell's instruments were in use.

"The trial of the suit of the American Bell Company against the infringing company representing Drawbaugh's claims terminated in New York on the second of this month. That company is at present under injunction, and it is confidently expected that the decision in this case, as in the others, will be in favor of the American Bell Company.

"Upon the announcement of such decision, injunctions will be immediately obtained against all the infringing instruments that can be found in use, including the 'Rogers' or 'Pan-Electric.'

"We disclaim any intention to do injustice to the gentlemen connected with the local Alabama 'Pan-Electric' Company, but an

investigation will show the following points in regard to the original enterprise to be substantially correct.

"The parties connected with the original 'Pan-Electric' enterprise claim that their instruments are outside the Bell patent, and superior to the Bell apparatus. These statements are wholly untrue. Their apparatus consists of a microphone transmitter and magneto receiver, and it transmits speech by Bell's method. Rogers' alleged improvements consist in a change in the form and arrangement of the electrodes. A great number of patents, covering slight changes in the mechanical structure of the microphone have issued from the patent office, all of which are subordinate to the Bell patent, and few of which have any value whatever. Starting with a patent of no value, and which they have no right to use, the projectors of this scheme are ostensibly attempting to build up a telephone system. It is strictly a stock speculation, and would have no serious effect on the legitimate telephone business except for the fact that a number of influential and well-known Southern gentlemen have been drawn into it.

"While the mere statement of these facts should preclude any necessity for argument in a law-abiding community, it is easy to show any competent business man that there is no profit in the telephone business on the basis proposed by the 'Pan-Electric' company, even if it were legitimate and no legal expenses were to be provided for. It is easy also to show that two or more telephone exchanges in a city are a positive disadvantage to the community.

"Not only is it certain that the Bell Company will protect its rights and those of its licensees, but the infringing companies are now fighting among themselves.

"It would appear that Mr. Rogers has been so anxious to make money that he has left the 'Pan-Electric' Company and their licensees in a very unfortunate position. It seems that he sold certain patents to gentlemen who formed the Rogers Secret Telephone Co., who transferred them to the National Improved Telephone Co., and it is stated that he subsquently resold the same patents to the 'Pan-Electric' Company. The National Improved Telephone Company is now about to take proceedings, and publishes the following caution in the New York *Herald* and *Times:*

"'Having been informed that the 'Clay Commercial,' 'Pan-Electric,' and 'Overland' Telephone Companies are using and offering for use telephonic instruments that infringe the patents belonging to this company, notice is hereby given that any party or parties using any of the said instruments that in fringe the patents of this company will be prosecuted according to law.

THE NAT. IMP. TEL. CO. OF LA.'

"This presents another prospect for a large legal expense account to be provided for out of the meager profits of a business to be established, or from the stock receipts furnished by unwary investors.

"☞ The prudent business man will think several times and investigate carefully before placing his money where the chances of losing it are so many, and will have occasion to thank us for putting him on his guard against an illegal and unprofitable enterprise.

SOUTHERN BELL TEL. AND TEL. CO."
By W. J. Cole, Supt.
W. L. Woodruff, Mgr.
Birmingham, Oct. 27, 1884.

Electricity and Gas.

The following dispatch was sent from Washington a few days ago:

"The opinion is expressed by the members of the American Gaslight Association, which meets here this morning, that the electric light scare is over for the gas men. They maintain that the use of electricity for lighting has improved the gas business, as it has caused the people to demand more light."

At the time when the electric light began to be successfully employed for private purposes we expressed the opinion that its introduction would probably create a general desire for more and better light, whether given by gas or electricity, and therefore we are not surprised at the above dispatch.

The public have been educated up to requiring a brighter and clearer illumination at night than that with which they were formerly content. It is just as it was after the introduction of gas, when people wondered how they had been able to so long endure the feebler light of oil lamps and candles, or after lucifer matches were invented, when they laughed at their former struggles with the old steel, flint, and tinder.

The electric arc light has given us a standard of illumination which makes us discontented with anything that fails to come up to it. The public would be dissatisfied if the streets and parks now lighted by arc lights were again allowed to get their only illumination from the old-fashioned lamps. The shops and restaurants which are now made bright by electricity would seem gloomy and intolerable if they were reduced to gas jets and the feebler light of a few years ago. They have also accustomed people to an amount of illumination which makes them demand a greater flood of light elsewhere.

But can the gas companies supply that demand? Undoubtedly they can do so partially, but they can never wholly satisfy it. Since the introduction of the electric light, inventors have given much attention to the improvement of the gas lamp, so as to increase the quantity of illumination it gives, and they have succeeded to some extent. The lamp in front of the office of the Manhattan Gaslight Company in Irving Place, for instance, sends out a great flood of soft light very agreeable to the eyes. But the result is only attained at the cost of an enormous consumption of gas.

The increase of the quantity of illumination from gas by the use of reflectors has also this decided disadvantage—it augments the amount of heat given out, and so strengthens the general preference for the incandescent electric light in places where the heat is injurious.

In the composing room of a newspaper, for instance, electricity has an advantage over gas in this respect which cannot be overcome. To get a sufficient illumination from gas so great a quantity of it must be consumed that the room becomes uncomfortable and unhealthy even in the coldest weather, while in summer it is almost insufferable. The incandescent lights, however, diffuse comparatively so little heat that they scarcely affect the temperature.

The gas companies, therefore, have to contend with a competitor which not only gives more light, but also furnishes the illumination without the heat inseparable from the use of gas. But doubtless the greater flood of light those accustomed to electricity are now requiring creates a larger demand for gas to imitate it in places where the heat is not so decided a drawback as in crowded rooms and workshops.—*N. Y. Sun.*

Comment and Criticism.

If electric light is ever to replace the systems of gas illumination in small areas it will undoubtedly be by means of the incandescent lamp. That the incandescent lamp is sure to replace all knowu methods for the artificial illumination of small areas we have no doubts. What is wanted to hasten this much to be desired end is to cheapen the electric light. We need cheaper electricity, and more economical methods for converting it into small lights. But, as we have already stated while speaking of arc lights, improvements are needed rather in the latter direction than in the former. It may be interesting, therefore, to inquire as to the directions in which we may reasonably look for improvements in incandescent lighting in the near future.

The extent of these needed improvements in incandescent lighting will, of course, be dependent on the present price of the electric light as compared with gas light. Speaking of the necessity for cheapening the electric light, we do not wish to be misunderstood. Incandescent electric lights can today be furnished at prices far cheaper than the cheapest gas ever sold, provided the electric light replaces a sufficiently great number of gas lights. It is the unanimous testimony of mill owners that not only is the incandescent light they have introduced into their mills better than the gas light formerly employed, but that it is far cheaper. But what is needed to-day is to so far cheapen the incandescent light as to enable it to economically replace a few gas burners. Can we reasonably expect this much desired result?

"Small users of the electric light are today," says a distinguished electrician, "pretty much in the same condition as Robinson Crusoe was, when he needed a new pair of boots and had to make them himself." Their cost in time and labor were necessarily great. So, too, with small private consumers of electricity. If they must manufacture the electricity themselves, the cost of plant, attendance, etc., would, it seems, render it very improbable that a small number of electric lights could ever be economically employed.

With systems of electric distribution, however, similar to our gas system, where the electricity is produced on a large scale, the matter is very different. The cost is so much diminished that a steady and reliable current can be supplied at low rates.

The great cost of the mains or copper conductors requisite for safely and economically carrying the large currents, used in incandescent lighting, would appear to prevent the electric current from being carried to great distances from the places where it is produced. The low electro-motive force of the current used in incandescent lighting as compared with the high electro-motive force employed in arc lighting would appear to render it impossible to extend the incandescent electric service to distances as great as the arc service, where circuits as long as 20 miles have been employed. To carry the powerful currents used in incandescent lighting, even a mile requires very heavy and therefore expensive mains.

It would appear, therefore, the isolated systems for incandescent plants are more economical in the more densely built parts of our large cities than systems of central stations; however, the difference between central stations and isolated plants may become so slight as to be inappreciable, since the amount of light to be supplied makes the isolated plant in fact a central station.

Mr. Edison, with his usual ingenuity has, by his three wire system, very greatly reduced the amount of copper required for carrying a current of a given lighting power. By coupling two dynamo-electric machines in series, and connecting a third wire or conductor to their neutral connection, he is enabled to increase the electro-motive force of the current supplied to the lamps that are connected in multiple series with the three conductors. The saving in the weight of the conductors thus effected is quite considerable, and will go a great ways towards increasing the distance that incandescent currents can be economically transmitted.

An incandescent electric lamp will give out its maximum of light the higher the temperature to which its filament is raised. The percentage of light emitted increases enormously with an increase of temperature, as high, we believe, as the sixth power. When, however, the temperature is raised too high, changes are produced in the carbon filament that hasten its disintegration, and thus greatly decreases the life of the lamp. The maximum commercial efficiency, therefore, is not consistent with the most ecomical conversion of electric energy into light. Improvements are needed in the preparation of the carbon filament that will permit its safe exposure to much higher temperatures than those now employed. When this is accomplished the economy of the incandescent lamp will be very greatly increased.

In order to obtain filaments that will safely stand a high temperatnre, several things are necessary. In the first place, the carbon filaments should be of high electrical resistance, so that the proportion of heat developed in the filament may be great as compared with the proportions developed in the rest of the circuit.

The filament should be of uniform electrical resistance in all parts, since if of higher resistance in some places than in others the highest safe temperature to which the filament may be exposed will be limited to the portions of higher resistance only. For the same reason the filament must be of uniform thickness or diameter throughout, and should be of as nearly uniform structure or density as possible.

The ingenuity of inventors has, to a very great extent, been directed towards obtaining carbon filaments that are at the same time of high uniform electrical resistance, and that are, therefore, uniform in density and homogeneity throughout their entire extent. Their efforts have not been limited to different substances for the preparation of the filaments but have extended towards the preparation of the filaments, and their carbonization, and their subsequent hydrocarbon treatment.

In the hydrocarbon treatment, the filament is raised to electrical incandescence, while in an atmosphere of some volatile hydrocarbon. Under these circumstances the filament, even when prepared with the greatest care, will show irregularities in its conducting power, consequently the temperature of the filament will be higher in some places than in others. These places will have more carbon deposited on them, from the decomposition of the hydrocarbon, and the film will gradually assume a uniformity in conducting power. As soon as the film glows with a uniform light the treatment is completed.

No little difficulty was experienced in the early days of incandescent lighting from the failure of even the most carefully prepared lamps. These failures were attributed to various causes. It was at last discovered that the cause of their failure was due to the absorption of air by the carbon filament. As soon as this was understood the lamps were exhausted, while the filaments were raised to electric incandescence. In this way a far better vacuum was obtained, and the life of the lamp greatly increased.—*The Bulletin.*

The Oram Time Machine, for giving accurate time by telephone, has been working for two months at Lowell, Mass., and for the past four weeks at Boston, and is giving excellent satisfaction. It is understood that the National Time Regulating Company, which controls the Oram patents, is now prepared to introduce the machines in the telephone exchanges throughout the United States.

The annual meeting of the American Association of Mechanical Engineers will be held on Wednesday November 5 at 8 A.M. The place of meeting designated by the management is No. 12 West Thirty-first street, New York. First evening session will be devoted to an address by President Sweet and the social reunion. Five hundred members and a trifle over are now on the list, and quite a number have been recently proposed, and we hope will be elected before the next meeting. We hope, for the first time in the existence of our membership, to meet with the society at this time, and shall endeavor to keep track of the proceedings for our readers. This association has in its make-up some of the best talent in the country, and it must make itself useful.

One of the most interesting achievements, in its line, is the recent photographing of what are known as Reichenbach's flames, this having been accomplished on sensitive dry plates prepared especially for the purpose. In total darkness a perforated blackened card was placed one-eighth of an inch above the poles of a permanent horseshoe magnet, the sensitive plate being set an eighth of an inch above the card. With five minutes' exposure a result was obtained, and this was repeated many times, the most remarkable thing being that sometimes there was obtained a positive and sometimes a negative image, under precisely the same conditions.

Review of the claims of Daniel Drawbaugh (illustrated); the Brooks Underground System (illustrated), by F. L. Pope; Electric Lighting at the Electrical Exhibition; interesting electrical correspondence from various cities. See *Electrician and Electrical Engineer* of November 1st. Ten cents per copy. Address, Electrical Publishing Company, 115 Nassau Street, New York.—*Adv't.*

Telephonic News

*** Writs have been issued this week by the Bell Telephone Company against the Telephone Manufacturing Company, of Toronto, and the Dominion Telephone Company, for injunctions against infringement of the Bell Company's patents, by selling and using telephones similar to those patented, and for damages.

*** The installation of the Fire Department telephone system at Montreal has been completed. It appears, however, that the apparatus will only be used for communications between the different stations, and will not be placed at the disposition of the public for giving alarms of fire.

*** The Spanish technical journals severely criticise the royal decree, which we published recently, on the subject of the establishment of telephone systems in Spain. In the first place, they prefer to see this enterprise in the hands of private companies, while the State has seized upon the business as a source of pecuniary profit. The price of subscription is said to be too high, and objection is made to the claim of the State to know all that is said on the subscribers' lines.

*** A deputation from the Plymouth Chamber of Commerce insisted, last week, before the administration of Trinity House, on the necessity for establishing telegraphic communication with the new Eddystone Lighthouse. The president stated that it was proposed, as we have already announced, to form a local company to lay a cable, which would be placed under the control of Trinity House, which would only have to give its consent to the enterprise.

*** We have received from the *Companhia de Telegraphos Urbanos*, of Rio de Janeiro, the list of subscribers connected with the telephone central office on the date of July 1. The subscribers, to the number of 714, are arranged in classes in alphabetical order, by professions, and according to their wire number in the central office. Outside of the great central office there are four auxiliary central offices in the different quarters of the city. The society has also installed a considerable number of private lines. The service is continued day and night, and the public is admitted to correspond by telephone in three public offices.

*** At Detroit a third telephone company filed articles of association at the County Clerk's office, last week, to catch what few lambs and suckers there are left. The company is called "The United Telephone and Messenger Service Company," and capital stock is fixed at $300,000, of which $20,000 is subscribed and $10,000 paid. Albert Ives, W. D. Robinson, Henry T. Thurber, George Farnsworth and Don M. Dickinson each hold forty shares. The Board of Directors for the first year consists of the five stockholders, with Don M Dickinson as president, George Farnsworth as secretary, and Albert Ives as treasurer. The stockholders are the same as the Michigan Postal Telegraph Company and the Bankers and Merchants' Telegraph Company.

*** The telephone wire which connects the royal residence at Ostend to the Theatre Royal de la Monnaie has permitted, during the last few days, of her Majesty the Queen of the Belgians listening, at a distance of more than 150 miles, to the execution of "Faust," "William Tell," and the general rehearsal of the "Barber of Seville." The royal family having quitted Ostend to sojourn several days at the Chateau of Lacken, the Administration of Telegraphs and the electrical engineering house of Mourion have to-day connected the royal residence with the Theatre de la Monnaie. This method of listening by telephone has, besides, a strange and peculiar charm, which makes it the admiration of all musicians.

*** It is announced that the United Telephone Company has made arrangements for the construction of a telephone line between London and Brighton, which will be ready for use at the end of next week. Several other lines for telephonic communication will soon be established between London and the principal commercial centers of England.

*** Experiments in the use of telephones on board ships have been made on board of the packet-boat, the Yarra, whose electric light installation we described recently. Two microphonic stations were installed, one on the bridge and the other in the stern. The first is placed near a very noisy small steam engine, and rests on a thin wooden partition subject to violent shaking; the second post is movable, and often placed in the open air above the propeller and rudder, in a place where it would necessarily be surrounded by a great deal of noise. Notwithstanding all these unfavorable conditions, transmission has always been very distinct, and the apparatus is in good order after four months of daily service. Other ships have experimented with a floating post in a small boat, which precedes the ship in time of fog to prevent collisions in the open sea.

*** The Dundee telephone system contains to-day 924 wires, over which are transmitted 42,000 communications per week. The first apparatus having only been installed in 1880, the development of the system has been extremely rapid. Two telephone companies were formed in that city without obtaining a very great number of subscribers, when the Dundee and District Telephone Company was formed, adopting a very reduced rate ($50 per year), which was only demanded from the moment the company should have forty subscribers connected. Thanks to these advantageous terms, the company had one hundred subscribers at the end of six months; in 1881 there were two hundred wires in operation; in 1882, 270 wires; and in 1883 the number had risen to 320, without counting private lines. Competition has reduced the price of subscription, which is now $25 per year, of which sum the company pays $2.50 to the government.

*** The telephone has entered so thoroughly into commercial life at Antwerp, Belgium, that its suppression would now lead to something like a cessation of business. A local Bell Company started the lines about three years ago, the original subscribers paying only 200f. (£8) per annum, but new subscribers are charged half as much again. For this the company lays the wires, supplies the instruments, and maintains the whole in working order. The police stations and also the leading medical men are put in communication, and the current is on day and night. It may be said that at least one in five of the principal business houses is connected, together with all the leading hotels and cafes. What astonished us was to see the words "telephone publique" put up at some quite minor *est minets*, or public houses, and we learnt that the instruments were at the disposal of all and sundry who might call for a glass of beer, as the telephone brings custom to the tap. There are also three telephone offices on the boulevards, whence the public can hold converse with subscribers for the small charge of 50c. (5d.) These offices also serve as tramway stations and ladies' retiring rooms. All the fire brigade stations are of course connected, as also the office of the new water works, owned by an English company. This company has also a private single telegraph wire between its office and the works at Walhaem, twelve miles off, that only cost £300, and seven minutes after the outbreak of a fire the pressure is increased all over the town.

*** The telephone was used, for the first time in connection with volunteer artillery practice, by the Risca detachment of 1st Worcestershire A. V., at the Nash ranges, Newport, Mon., England, on Monday week. A 64-pounder was brought up to 2,500 yards from the marking point, and 6,000 yards from the target, but so placed that the detachment working the gun could not see the target. The firing was rather wild at first, but owing to the directions given through a Gower-Bell telephone, with portable lead, consisting of a double cable, as to the effect of each shot, the gun was eventually trained to cover the target. The whole apparatus consists of a cart and limber carrying the 4,000 yards of wire in 500-yard sections for convenience of carriage, the lengths being coupled up by an ingenious joint devised by Mr. G. Wilson, electrical engineer of the Risca Collieries, by whom the whole apparatus has been arranged and supplied. The result was considered by the volunteers, under the command of Col. Cumings, a complete success.

A Telephone Decision in Bell's Favor.

The Examiners in Chief of the Patent Office, in the celebrated telephonic interference patent case, have sustained the decision of the Examiner of Interferences in favor of Bell as to issues A, B, C, E, F, I, J, and L, and have reversed the decision so far as it applied to issue "G" (which involves the principal feature of the telephone), which was awarded to McDonough, and which the Examiners in Chief have decided in Bell's favor.

Messrs. Fisher, Clark, and Bates, Examiners-in-Chief of the Patent Office, have rendered their decision in the matter of Voelker *vs.* Gray *et al.*, a patent interference case involving the invention of the speaking telephone. Of the fourteen original parties there remain now only six, viz.: William L. Voelker (two applications), Thos. A. Edison (five applications), Elisha Gray (four applications), John H. Irwin, James W. McDonough (one application each), and Alexander G. Bell (two patents). The Examiner of Interferences had awarded priority of invention to Bell in cases A, B, C, E, F, I, J and L, and in cases "D" and "No. 1" to Edison and in case "G" to McDonough. Case "G" is generally regarded as the principal point at issue and practically covers the telephonic invention, for it is an application for "a telephonic receiver consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality."

Bell is the only one of the contestants having patents. Before taking up the issues in detail the examiners say: "The courts have held that those seeking to overthrow patents should be held to strict proof of actual and successful prior embodiment, and the office has applied the same rule to those asking a patent for that which has already been patented to another. In this case the rules of the office are to be applied with strictness, for Bell's patent has not only not been declared invalid by any court, but it has actually been sustained, and upon a record which is a part of the record here. It follows, therefore, that although satisfied from the evidence that Bell had made the invention before the filing of his application, it will not be necessary for the general purposes of this case to review those portions of it which have led to this conclusion. It will be sufficient to determine whether or not the other parties have overcome his record dates."

Issue "G," "a telephonic receiver consisting of the combination in an electric circuit of a magnet and a diaphragm supported and arranged in close proximity thereto, whereby sounds thrown upon the line may be reproduced accurately as to pitch and quality," was awarded by the examiner to McDonough. The parties were Bell, McDonough, Gray, and Edison After an exhaustive review of the great mass of evidence adduced upon this point, and stating at length the reasons leading to the conclusions, the Examiners say:

"Upon the whole, McDonough's proofs cannot be held to be sufficient to overcome Bell's record dates. We have seen that a party contesting the right of a patentee must show complete and perfect apparatus. That McDonough did not have this is clear. Had a patent been granted to him for it as described in his application, or as experimented with in June, 1875, the public would have been no wiser than before. It still would have been ignorant of the method and apparatus for speech transmission, for no instrument working upon its principle of making and breaking contact can accomplish that result. In this respect McDonough gave no more to the world than Reiss. As was said of Reiss by Mr Justice Lowell, in American Bell Telephone Company *vs.* Spencer, a century of McDonough would never have produced a speaking telephone."

Issue "J," for the combination with an electro-magnet of an iron or steel diaphragm secured to a resonant case for rendering audible acoustic vibrations, is confirmed to Bell, as is issue "L," which concerns the polarized armature in the receiver.

Edison's claim is supported in issue "No. 1," for a spring carrying one electrode of the circuit of a telephone and constantly pressing against the other electrode and diaphragm.

The Final Splice.

COMPLETION OF THE LAYING OF THE COMMERCIAL CABLES—SEVEN THOUSAND MILES OF CABLE UNITED AT CANSO AND WATERVILLE.

A message was received by Mr. George G. Ward from the cable steamship Faraday last Tuesday, saying that they were making the final splice of the Commercial cable. This completes the great work in which the Faraday has been engaged since the middle of last April. The Faraday, after the shore end was laid at Coney Island on Saturday last, dropped down to the buoy, which was over two miles from shore, and spliced the shore end of the cable to the intermediate, which she had on board. Then she sailed for the next buoy, about eighty-five miles distant toward the east, and the dispatch to Mr. Ward shows that the work was done at that point as successfully as at all others. There was not a hitch in the arrangement since the Faraday left Coney Island.

The two cables now unite at Cape Canso, Nova Scotia, and at Waterville, Ireland. Both are nearly seven thousand miles long. Cable stations and comfortable quarters for the accommodation of the electricians, operators and other members of the staff have been erected at both termini of the main cable, and of the branches at Rockport, Mass., and Coney Island.

Communication over the Rockport end was established on the 20th of July. The entire period occupied in laying the two Commercial cables was exactly six months and four days. The New York cable is connected at Coney Island with direct telegraphic communication carried underground to the company's offices, at the corner of Wall and Broad streets. This is the first ocean cable which has ever had its terminus in the mart of a great city. There will be, therefore, a special advantage in the avoidance of the delays and occasional uncertainties of land wires in connection with cabling.

The steel steamer recently launched, and designed as a repairing vessel for the use of the Commercial Cable Company, will be stationed at Halifax. The two cables are duplexed by Muirhead's system, rendering them practically equal to four distinct cables. Sir William Thomson's latest invention—the siphon recorder, a beautifully constructed apparatus, which practically supersedes all former systems of ocean telegraphy—is attached to the Commercial cables, and will bring down the time occupied in the actual transmission of the messages to the lowest possible fraction.

The Atlantic Cables.

It having been reported that both cables of the Western Union Cable Company had met with serious accidents, the London *Standard's* correspondent at Penzance telegraphed as follows on Tuesday:

"It has been ascertained so far as actual tests have gone that only one of the cables has been really severed. It was on Friday evening last, at 9 P. M., that communication ceased with one cable, and at four on Saturday morning the second and only remaining cable of this company became inactive. The test which has been applied

in respect to the second cable leads those who have made it to imagine that it is not broken, but that the gutta percha is pressing on the wire itself. It is believed that the cables have been thus interrupted eighteen hundred miles from the Land's End, the one that has broken having gone somewhat nearer the English coast than the spot at which the second has been interfered with. It is not credited, however, that icebergs have had anything to do with the matter. It is feared that the Western Union Company will not be in a position to renew operations for several months. An electrician from Messrs. Siemens is expected in Penzance this evening to test the cables, with the view of definitely ascertaining where the accidents have occurred."

One of the Mackay cables just laid was also *hors de combat* on Monday. It is thought the Western Union cables will take some time to repair, but the Mackay-Bennett can be spliced in a short time, as the Faraday is on the spot, and can effect the necessary repairs after laying the section of cable she has now on board.

What Constitutes a Good Telegraph Operator or Clerk.

There is, I suppose, no question which has excited so much discussion in telegraphic circles as the one which heads this article. Nor is there another that might be asked of anything like the importance that appertains to this one. In attempting to answer it, I shall endeavor to eschew dogmatic assertions as far as possible, my desire being rather to indicate the various factors to be considered in arriving at a solution of the problem, and to initiate a discussion which cannot but be of the greatest interest and importance to those to whom "dots and dashes" mean bread and cheese.

To begin with, there are a few attributes which should be common to all clerks, and amongst them may be enumerated regularity and punctuality. These characteristics are of great importance in all businesses where time is an element, such as in railway, postal and telegraph departments. Except for the fact that in telegraph working seconds are more valuable than in the other sections of public business, punctuality is equally essential in all of them. These qualities are necessary, not only for the sake of securing the expeditious transaction of business, but they should possess in themselves a sort of selfish interest. There is, in the first place, a bad reputation to be considered, while in the second place is the equally important fact that very frequently the late arrival of a clerk means the otherwise unnecessary detention of another. If there is anything in this world which the average man who is entitled to a definite period of labor feels as a hardship, it is that the expiration of his term of duty should be involved in uncertainty. If he has to await the arrival of a fellow clerk who is habitually or frequently late, even if only a few minutes, and who sometimes does not put in an appearance at all, he is debarred from the privilege which he should enjoy of being able to make appointments with his friends, or even of arranging for the prompt serving of his meals on his arrival home; while, if that home is a few miles away from the office, there is the further disadvantage of losing a train. Life is made up of small things, and it behoves each man to interfere as little as possible with the small comforts of his neighbor. One would almost think that the fear of retaliation would prevent the infliction, but that is a feeling which is seldom excited, or which seldom shows itself. The man who is punctual in arriving, in order to give himself a claim to punctuality in departure, is not likely to arrive late, even when the prospect of departing promptly is small.

A telegraph clerk should, of course, be as expert as possible, but it is not in the power of all to attain a high standard in this respect. Nevertheless, however dull the sense of touch, of sound or sight, however ungainly or stiff the fingers may be, there is still a chance left for a slow hand to become a moderate operator on every form of instrument in use. No matter what others may aver, I maintain that there is no ear amongst us which cannot, by a little industry, acquire a fair amount of talent for sound reading, nor is there one who is absolutely unable to "punch." All that is requisite is a little perseverance—the rest comes by practice. I grant readily that it is rarely possible to make a telegraph clerk of a man advanced in years who has never before touched an instrument, but I think it impossible that when the fingers have been accustomed to one form of instrument they should be unable to learn to exercise them on another. And yet it is no uncommon thing to find a clerk, who is proficient on the sounder or at the key, declare his inability to punch a sheet of news or read a message on the needle. Should this be so? Or does not the clerk who speaks thus belie himself? A man who can only manipulate a key, even if there be few equal to him on that instrument, I should be loth to regard as a *good* clerk. He is a good sender (or a good reader, a good puncher, or a good needle clerk), and that is all that can be said for him. To be a good clerk is to be good at every form of instrument in the office. I firmly believe that the inability in the great majority of cases arises from sheer obstinacy and an absolute determination not to learn. Fortunately, there is not wanting a sign that promotion in many offices will be, to a great extent, dependent upon the ability of those concerned to turn their hands to any instrument at which their services may be required.

Of course, when a man has a preference for, or is brought more in contact with, a certain form of apparatus, it is only natural that he should become more expert at that than at any other. But expertness is not the only requisite. There is such a thing as care, and a clerk who takes that interest in his work which he should do will exert himself to become acquainted with the various terms, phrases, names, etc , which frequently come under his notice. I have known men who could, did I desire the information, tell me the name, politics and constituency of every prominent M. P.; the current price of all the important stocks, of corn, of metals, etc., and the names and doings of many of the best race horses. Such men are an acquisition to any office, and such a knowledge goes a long way towards forming a *good clerk*. I venture to assert that whether the perforator were made to move at 10 or at 40 words per minute, that man could not be fairly regarded as a good clerk who would, in punching the description of a race, say that the winner "made all the morning and won by a week," instead of "made all the running and won by a neck." Nothing but the grossest carelessness or the most willful ignorance could evolve such rubbish as this. Nevertheless, such errors (!) are not altogether rare. Would that they were. Bad writing is no excuse.

Again, it does not become a good clerk to say that he is unable to read a bad slip or indistinct signals. Good signals or good marks a tyro may read; but we should gauge a good clerk by his ability to read a bad or difficult slip. But how often do we see the veriest nonsense written down because "it is on the slip." Surely, then, common sense is a factor not to be ignored. The telegraph clerk ought to have known that when Lord So-and-So instructed his servant to meet him at the station, it was the "gig" that was wanted, not the "pig." One error, the result of indistinct sending or of carelessness on the part of the receiver, occurs to me, and that is the substitution of "G" for "me." This is a frequent error, and must, as in outside telegraphic circles the similarity is unknown, cause a deal of trouble. We can imagine the condition of Mrs. Smith on being asked to "meet G" (who is "G"? she'd like to know), "at the usual place an hour hence."

I think, too, that it is more than desirable that a clerk, to be *good*, should know something of the apparatus with which he is working. Nothing to my mind is so humiliating as to have to call for aid at every little hitch. Often have I known a circuit to be stopped for five or ten minutes when one turn of a screw or the movement of a plug would put matters right. Over and over again have I heard of an instrument that "wouldn't run" (because the spring had run down, and it wanted winding up), or of another that "wouldn't mark" (because the ink-well was empty). Several times, too, have I heard that the attention of a distant station could not be gained (when the line-wire was off the instrument, or the armature was screwed down on to the coils). Instances of ignorance and carelessness of this nature I could mention *ad lib.*, but I have, I think, said sufficient to make clear my view.

It must not be forgotten that "temper" is a very important consideration. The clerk who, having attained a certain degree of efficiency, declines to work amicably with others who are less experienced than himself, not only confuses the distant clerk, and so hinders his progress, but, in my opinion, humiliates himself very considerably. How petty—nay, how silly—do the words "Get clerk" appear on a "sheet of blue;" and yet I suppose there are no two words so frequently on the lips, or rather the fingers, of many a telegraph clerk than these. Often the fault is on the line, or in one of the instruments, and then the impatient clerk looks, if he does not feel, more ridiculous than ever.

I have already, I fear, trespassed farther than I should have done, so I hasten to my conclusions, which I may summarize by saying that the attributes of a good clerk are punctuality, regularity, ability to work any form of apparatus (with exceptional dexterity on one or two forms), carefulness, acquaintance with frequently-used names, terms, etc., patience, and a knowledge of the general features of the various systems of telegraphy.

I might have enlarged upon the problem, Speed *vs.* Accuracy, but must leave that and a few other points to be developed, as I trust they will be, in the correspondence columns. The subject, I feel sure, is of great importance to all who have the welfare of the profession at heart and take pride in their work. I have been impelled to say what is here said from a conviction that the qualities of our clerks and their work are rapidly deteriorating.—*The Telegraphist.*

A railway telegraph is said to have been invented by Mr. Lucius J. Phelps, which is thus described: It is based upon electric induction, that is, the communication of the electric current is not made by metallic contact, but by induction of the current through an air space. Take an ordinary railroad car, fitted up at one end with the regular battery, Morse instruments, etc., from which proceed a number of insulated wires into an iron tube about two inches in diameter, which runs down (with the wires inclosed) from the operating end of the car to the bottom, and is carried along the bottom service of the car about ten inches above the track, so as to clear every object, then, after running the whole length of the car bottom, it returns up again to the operating table in the car. Along the center of the track, on the top of the ties, is laid one insulated wire, boxed up and out of harm's way, which drains the electric current by induction from the car as it rushes along the track, the current of electricity going from the wires in the iron pipe at the bottom of the car through the air to the wire laid along the center of the track. By this arrangement it is claimed that a moving train can always keep up telegraphic communication.

.... The announcement that the Mackay-Bennett cable is to cross the East River on the big bridge causes increased interest in the general telegraph and telephone service performed by this structure. This bridge has proved a great boon to those immediately interested in the telegraph system between New York and Brooklyn. The casual observer passing across the bridge sees only a few telegraph wires running under his feet, whereas there are really 290 of these wires, according to the statements of the bridge authorities. The rent for these remains as at first established, $30 per year for each wire. The revenue last year amounted to $8,700.

TELEGRAPHIC

.... It is announced that the Bourse of Madrid will soon be connected by direct telegraph wires with the Bourses of all the other European capitals.

.... The receipts of the English Department of Telegraphs, from April 1 to September 20, were $4,375,000, against $4,350,000 for the same period last year.

.... Last week a Rapid Telegraph messenger boy was found dead in the street. It is supposed something scared him and he started to run.—*Brooklyn Eagle.*

.... A recent estimate, made by means of a very intricate testing apparatus, places the rate at which an electric dot travels over a telegraph wire at 16,000 miles per second.

.... The tribunals of Philadelphia have decided that the proprietor of a house has the right to cut telegraph wires which have been placed above his house without his consent previously obtained.

.... The submarine cable between Sicily and Malta is interrupted. In consequence, telegrams for Malta and Tripoli ought hereafter to be sent solely by way of France, and those for Alexandria, Aden and southern Africa by the way of Zante.

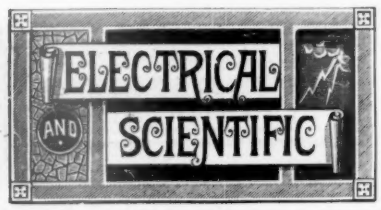
.... The *Grande Compagnie des Telegraphes du Nord* announces that the service by steamship between Sharp Peak and Fou-Chou, in China, is resumed. Dispatches from Fou-Chou can be accepted in figures or in letters, and will be transmitted at the risk of the sender at the rate of 10 fr. 50 per word.

.... The *Times* correspondent at Shanghai states that one of the lessons taught by the engagement between the French and the Chinese on the Min is the value of the admirable electrical apparatus for telegraphy, used nightly. This and other points, he says, deserve the serious attention of our naval and military authorities.

.... The result of the race for the Goodwood Cup (England) has been telegraphed from London to Melbourne in 1 hour 53 minutes. The dispatch, leaving London at 3.17 P. M., arrived in Melbourne at 2.50 A. M. The difference of time between London and Melbourne being 9 hours 40 minutes, the calculation is easy to make.

.... It is announced by the International Ocean Telegraph Company that, owing to the breaking of the cable south of Jamaica, telegraphic communication between Cuba and the other Antilles, with the exception of Jamaica, is interrupted. During the interruption messages will be sent by steamers from Santiago de Cuba for Puerto Rico and San Thomas on the 5th, 15th, 17th and 25th of each month, from Jamaica for San Thomas on the 10th of each month, and from Jamaica for Barbadoes on the 24th of each month.

... The Directors of the Western Union Telegraph Company have issued an appendix to the annual report, giving the report of the committee which was recently authorized to examine the assets in the treasury. The list of securities now in the possession of the company differs but little from the list published a year ago. Their aggregate par value foots up a little more than $14,500,000. The principal holdings of the Western Union are as follows: Twenty-three thousand eight hundred and sixteen shares of California State Telegraph Company stock, par value, $2,381,000; 19,438 shares Gold and Stock Telegraph Company stock, par value, $1,943,800; 16,231 shares International Ocean Telegraph stock, par value, $1,623,100; 58,300 shares Pacific and Atlantic Telegraph stock, valued at $1,457,500; 12,075 shares Bell Telephone Company, of Canada, $1,207,500, and 6,290 shares Franklin Telegraph Company, valued at $629,000. The Western Union Company also holds $65,300 of the bonds of the Gold and Stock Telegraph Company and 1,500 United States 4 per cents.



* * The electrical resistance of aluminium commercially pure is 1.96 that of pure copper, while the addition of a small quantity of aluminium to copper greatly increases its resistance, both electrical and mechanical. For wires of equal length and weight, the resistance of aluminium is a little less than that of copper.

* * Messrs. W. Hallock and F. Kohlrausch have made a number of experiments on ordinary long-bar magnets, in order to determine with exactitude the true position of the poles in the length of the bars. Fourteen magnets were used, some of various conditions of hardness, and in general they were in the form of steel cylinders magnetized in the direction of their axes. Their results, taken in connection with those of Schneebeli and Helmholtz, agree in showing that the effective poles of a magnet are about one-twelfth of the distance of the length from the ends. This result is, according to the observers, in all probability correct to within five per cent.

* * Mr. Arthur E. Bostwick has made an elaborate series of experiments on the supposed influence of light in altering the resistance of metals. Since the diminution of resistance of selenium, when a ray of light falls upon it, was discovered by Messrs. May and Willoughby Smith, Dr. Richard Börnstein has attempted to show that not only selenium and tellurium possess the property in question, but other metals, such as gold, silver, platinum, also possess it. This effect was not verified by Siemens and Hausemann, of Berlin, and now Mr. Bostwick's researches have not established the fact asserted. His conclusion is that "if light causes any diminution in the electrical resistance of metals, it probably does not exceed a few thousandths of one per cent.

* * In order that the person ringing an electric bell may be able to tell whether, on making contact, the bell actually rings, Mr. Douglas Mackenzie has devised the following arrangement. Besides the press-button, and let into the wall, is a simple telephone receiver of the Elisha Gray or Bell model, and consisting of an electro-magnet with a soft-iron plate armature free to vibrate over one of its poles. The sounding or "clicking" core of Page may also be employed instead of the diaphragm armature. This electro-magnet is formed up in circuit with the bell and battery, so that when the bell is in action, with its contact interrupting the current, the telephone or electro-magnet will emit a musical note or hum, which, when heard by the person ringing the bell, informs him that the bell is ringing, always supposing that the current is strong enough.

* * Among the things at the exhibition of electrical invention which a very few years ago would have seemed entirely impossible to unite in any manner with electricity is a brickmaking machine. Its claim for existence in an exposition of this kind is an electrical-encounter attachment, which performs the quite human service of counting the 25,000 bricks, which the ingenuity of Chambers, Bro. & Co., of Fifty-second street and Lancaster avenue, the proprietors of the device, managed to send through the machine in ten hours; that is to say, the machine at the Exhibition makes 25,000 bricks in ten hours. It is known as size "C" and has half the manufacturing capacity of its big brother, size "B." The strangest feature about the machine, perhaps is the fact that the bar of clay which through its operation is turned into sanded bricks, itself regulates the speed of the machine. This is by means of the "automatic cut-off," which transforms the issuing bar into lengths of brick as it emerges from the machine.

The bar starts from tempering portion of the machine, which is, by far, the largest part of it. It is a strong cast-iron conical case, in which revolves a horizontal shaft, into which are set spirally strong tempering knives or blades of wrought-iron or steel, so that as they pass through the clay they move it forward. The clay being stiff and not having much water on it, is not liable to slip before the knives, but is cut through and through and thoroughly tempered, the air escaping back through the untempered clay, so that by the time the clay reaches the small end of the tempering case it is ready to be formed into bricks. The size "C" is claimed by its owners to make the best machine-made bricks and even to excel the hand-moulded "clots" for making press bricks.

The Discussion on Storage Batteries Before the Electrical Conference in Philadelphia.

The sudden outburst of interest in secondary batteries at the time the Faure battery was first introduced in England led to some unfortunate results in the shape of bankrupt electric companies. The first hope was that sufficient electricity to do most of the household work, and give all needed light, would be left at one's door each morning. The idea of "bottled electricity" was a taking one with the public, especially as it was introduced with the best of indorsements; but the secondary battery has not proved to be such a boon as was expected. In view of this great public interest, the discussion on the subject by many of the leading electricians of England and America at the Electrical Conference was of especial importance. The discussion shows, as well as anything can, the present state of opinion among those most capable of judging of the secondary battery. The discussion was opened by Mr. W. H. Preece.

Professor W. H. Preece, London, England:—I have been called upon somewhat unexpectedly to open a discussion on this question of storage batteries; and I regret very much that I have no notes with me to refer to, and that I shall have to trust a good deal to my memory.

Now, storage batteries have been very improperly called storage batteries, and I very much prefer to call them secondary batteries. It is quite true that this subject of storage batteries is one upon which there is a good deal of misconception, which has arisen from the introduction of the word "storage." Now, these secondary batteries have been before the world for over twenty years; and all the physicists who go to Paris almost invariably meet with Plante himself, the father of this instrument. For the past twenty years, nearly, it has been one of my great pleasures, when I visited Paris, to pay a visit to M. Plante, who has shown me, as he always shows everybody who sees him, the progress that he has made. M. Camille Faure conceived the notion of coating the plates of lead with the oxide of lead. These secondary batteries had not attracted much attention, although Plante's papers deserve the most careful consideration from all electricians; but M. Faure found that by coating the positive plate of the secondary cell with a layer of minium—red oxyde of lead—he considerably hastened the production of the plate. Plante simply depended upon the electrolytic action of the current in peroxydizing his plate. This is an operation that sometimes involves months. Faure's battery fell into the hands of a man who put forward one of the most diabolical schemes that Paris has ever produced. A man by the name of Phillippart placarded all Paris with the most outrageous notices of what this great battery was going to do. Batteries were to be distributed, like milk and ice, at our doors; so that motor power could be obtained and used in our houses, and light could be obtained from them. The result was, that a considerable sensation was created, and an attempt was made to bring out an official swindle, but it did not succeed. Another gentleman was associated with him by the name of Mari. They became associated in London with a gentleman who holds a very high position, and occupies in the financial world a very important place, indeed, as the head of the great firm of Mathie, Johnson & Co., who are large metallurgists. Mr. Sellon joined himself with a Mr. Volckmar. They brought out a compound battery, and a company was formed in London to develop this scheme, and a great deal of money was collected, but all of it has been lost. Mr. Volckmar himself succeeded in playing his part of a plunderer sufficiently to ride about London in a manner indicating a person of great wealth. The fate of this man was sad, indeed, for his body was found in the Seine with a bullet through his forehead. Now, two or three other men had been working at this idea—Mr. Tribe and Professor Bridgeton. They approached the matter in a truly scientific spirit, and the result has been that Mr. Tribe has brought out a form of secondary cell, although it is not yet in the market, that is a great improvement upon anything that has ever been brought out before. But all these persons have been working silently upon this subject, and have gone back to Plante's original work, and they have followed Plante's original methods. The batteries that I am going to speak about are hollow, and the modification of Plante's simple lead cells, the simple cell being two plates placed in a dilute sulphuric acid, one plate oxydized, and the other plate pure. Now, as regards the uses, I have made a great many experiments with these secondary batteries; and first I will speak of the experiments made of their use in telegraphy. Some time ago the idea was mooted that a considerable economy might be effected in the working telegraph if dynamos were used for that purpose. The dynamo machines are used by the Western Union Company, and they employ them for their circuits; but they are not used in England, and we have failed to use them for a very obvious reason, which is simply this, that in England we do not work with "closed circuits." We work our instruments with rapid reversals; our automatic system, which is so very extensive, sometimes giving us the result of the transmission of three hundred words per minute, with very rapid reversals of very minute currents. It is absolutely essential that these currents should be uniform in their character. Now, the currents produced by the dynamo machines are not uniform. If a telephone be inserted in a secondary circuit, you will invariably find that you can hear sounds which are indicative of variations of the current, and these variations are fatal to a fast speed of working. But when you use a dynamo, and utilize the current of the dynamo in preparing a secondary battery, you then get a means by which you can produce currents of absolute uniformity. The secondary battery current flows out absolutely uniform. And, again, it has the great advantage of giving you a battery with a very low resistance. The electro-motive force of an ordinary cell is as low as two volts. You may take it, as a rule, to be two volts. Its internal resistance may be made whatever you like. Now, I had three series of cells made, one set being Dr. Tribe's, and another Plante's; and from each of these sets—there were eight cells to each set—from each of these sets forty circuits were worked; that is, each battery had forty distinct and separate circuits, so that practically we had a hundred and twenty circuits running from these three secondary batteries. Although all worked for about three months—I think the exact time was ninety-six days—all these circuits worked uniformly and perfectly, gave no trouble that would necessitate even the glancing at them during this whole period of three months, and without any attention, when suddenly one failed, and immediately afterward another failed, and then the third failed. They were charged up again, and then they went on for another three months. And they have behaved as well as one could possibly wish, so much so that one of the first duties that I wish to discharge, on my return to England, will be to arrange for a large supply of these secondary cells, and a further use on a large scale at our battery for the Post-Office. We have in use, at the General Post-Office in London, six hundred and fifty circuits centralizing there, and we are now utilizing about twenty-two thousand cells. I think it more than likely we shall be able to work the whole with probably not more than five thousand cells.

Now, as regards electric lighting. I have already used secondary batteries for electric lighting; I have used them in the Post-Office, and I have used them for my own house. My house is in a portion of the country through which no lines pass for the purpose of electric lighting, and they cannot be found within a reasonable distance; so, if I wanted to light my house by electricity, I must be dependent on my own supply of electricity. I light my house by gas, but I burn my gas in my garden, and I extract from it that which I want, namely, light; and I discharge into the air of my garden that which I do not want, namely, poison. My gas is employed in working a small gas engine of two horse-power. It is the gas engine which works a small Gramme dynamo, which, when worked at its full power, gives me forty-two volts and fifty-two amperes. These fifty-two amperes are directed into seventeen cells. The cells are Plante's original cells. The plates themselves are two feet square, and in each cell there are twelve of these little lead plates. The lead plates are made up of four thin sheets of lead, each sheet being about one thirty-second of an inch thick; and they are perforated in squares regularly all over, and these four thin plates are tied together—they are almost woven together—they are tied together with thick worsted. They are arranged in pairs—six on one side forming one pole, and six on the other side forming the other pole. They are placed inside of an ordinary pitch pine box, and the insulation of the cell is maintained by a thin India-rubber bag which envelopes it. It is a loose India-rubber bag of about the same shape, and, when the plates are put in, it forces the India-rubber out, and the bag takes the exact form of the cell, and it makes the cell thoroughly water-tight and thoroughly electricity-tight. I have seventeen of these cells, all arranged in a series; and my engine, which generates these currents and charges these batteries, is in my garden. My gardener has the gas engine under his charge. He is an ordinarily intelligent gardener. When he comes on duty in the morning, he lights the gas in the gas engine, and starts the dynamo which charges my battery; and when he goes away to his dinner, after the engine has been working for three or four hours, the battery is prepared. I go home in the evening; I have got a store of electricity. I have every room in my house fitted up. I have at my bedside a most charming little light, with no smoking, and no trouble with a wick, and no heat—a mellow light by merely turning on my tap. I have the softest and most delicious light you can conceive of thrown upon my paper or thrown upon my book. I have had this going on for four months, and I have never had any bother, except on one occasion, when the gardener put his foot on the wrong place, and the engine came down upon his foot, crushing his toes.

I have a strong impression that, for all isolated places similar to mine, the storage battery is an essential thing, and I think that some one is bound to work out this question. Several are now pegging away at it. Sir William Thomson spent much time in investigating this subject, and has given it a great deal of attention, but has not succeeded simply because you can use a Plante cell untrammelled by any patent. It is at our disposal, and nobody will interfere with you. If anybody else chooses to follow my example, I think they can do precisely the same thing. But there are, after all, one or two other uses for secondary batteries. Now, I have been very luxurious and very extravagant in carrying out this arrangement. For instance, I have a little daughter who has a very pretty doll-house. Her doll-house consists of six rooms, and each room is well furnished and well populated with charming little dolls. It is, of course, necessary that each room should be supplied with a charming little electric light; so each room is supplied with this light. Then I have a cigarette lighter, consisting of a piece of platinum which can be rendered red-hot by the secondary battery. The difficulty in doing that sort of thing with the usual mode of distribution

is that you want the benefit of cutting off a portion of your current. I interrupt a current, flowing, say, six-tenths of an ampere, by putting into the circuit, by a switch, a secondary cell, that diminishes the light, and sets up a counter electromotive force of two volts for the time being. While the cell is in the circuit, your light is a little dim; but when I take from the poles of that secondary circuit two wires in connection with a piece of platinum wire, then the current passes through the platinum, and this current is due to the two volts from the secondary cell. This piece of platinum wire is heated up with a current quite sufficient for the purpose, with only two volts.

Now, there is another field in which satisfactory experiments have been made with secondary cells, and that is in lighting up trains of cars by electricity. This has been done on one of our railways between London and Brighton. The railway company has been for some months past lighting up one of its express trains with secondary batteries. The dynamo is worked by the motion of the wheel, and the dynamo charges the battery during the time that the train is working, and the battery is being charged during the whole of that time, and the current is being extracted from the battery; so that you have a light in your carriages which is perfectly steady, and quite independent of the motion of the train. And that leads me to a point which I omitted, and which led me to work so hard at secondary batteries; and that is, that a secondary battery renders the current produced by the inconstant engine and the inconstant dynamo perfectly steady.

It is a difficult thing to say that, in making an appliance of any kind, we have reached absolute perfection; but I can say this, that, when you have a secondary battery inserted in the electric light as a shunt (p. 388), it renders your current perfectly uniform, and your light is as near perfection as it can be. Supposing that your lamp requires fifty volts, then you will require twenty-five cells; and I should think myself that it would be quite possible to make cells for this purpose that ought not to cost more than five shillings a cell. You put twenty-five of these in cells: the first current that goes through, simply charges the lead plates; one is coated with oxyde, and the other is clear; and you get a counter-electromotive force of fifty volts. The consequence is, no current whatever passes through the secondary cell unless it has been raised once to 50 volts. The whole current goes through your lamp unless there is flickering of the engine. Then, if there is flickering of the engine, the energy that is stored up in the battery passing through the lamps makes the light uniform, and in that way you get the storage effect by the use of the secondary battery.

There are certain defects that have developed themselves in these batteries, that have been gradually cured. The great defect in all secondary batteries is due to buckling—a fact due to the formation of peroxyde upon the plate. You will find that your lead plate will buckle up into all kinds of positions, and the two plates will come into contact. This difficulty I have sought to overcome by supporting the two plates by means of a plate made of paraffine-wood; but the most effective arrangement that I have tried is ebonite. This ebonite is furnished, stamped out to the proper size, and is very light and very thin, though quite equal to preventing all buckling.

Secondary cells have not been in use long enough to enable us to determine how long they will last. I have had them in use for four months, with a sign of but little disintegration of the positive plate. I think that the plates will have to be renewed only about once in every two years. Those that I have in use were recharged at the end of four months.

The charm of the whole thing is such, and its cost is so trifling, that I shall keep it in my house; and I am quite sure that all those who have worked in the same direction in regard to this matter of electric lighting will never give it up. The electric light itself has some sort of a charm about it. Objection is made to the cost of introducing it; but I have protested often and often against the comparison that is drawn between the cost of gas and the cost of electricity. The two things are not to be compared. When we indulge in luxuries, we don't compare the cost of the luxuries with other things. If you want fine 1834 port, you don't compare its price with that of ordinary claret. If you want to indulge in a fine pheasant, you don't compare it with the old cock that crowed before Peter. So, when you have a delightful luxury like electricity, you don't want to compare its cost with that of gas or sperm candles, or any other mode by which life is shortened and ultimately destroyed. Here we have something that in the out-of-the-way houses tends to lengthen life and to satisfy us, giving us something cool and delicious; and I say all comparisons with gas are utterly ridiculous. In reference to these enterprising light companies, they will soon bring electricity to our doors; and we will all take it. When people can get electricity at their doors, and can get it without much cost, as indeed they can, they will certainly have it. So I look upon the days of gas as being numbered; but gas is a most important power, and its uses are just in their infancy. The days of gas as a distributor of power and heat are coming. At the same time, electricity is going to supply light such as we want.

There are many facts connected with the working that I should have liked to give you. I should have liked to give you the efficiency. I have made careful experiments as to the efficiency of the storage up to the present time. The cost is certainly within the reach of every man in this room. Every single man in this room can afford the comfort which this light will give him; and an electric plant will enable him to live four or five years longer in this world than he would without the electric light.

Prof. W. H. Harkness—I was very much pleased and gratified at hearing Mr. Preece's remark as to the use of secondary batteries. After all that has been said on both sides, it is gratifying to find that we have a certain and valuable method of lighting which is effective and economical. I wish also to add my testimony on one or two points which Mr. Preece has mentioned, and that is to the courtesy uniformly shown by M. Plante to any one who visits him at his laboratory. I had the pleasure, with some friends, of visiting his laboratory, witnessing many experiments made with a large number of secondary-battery cells. As we all very well know, his invention has resulted in the adoption, not only of those secondary cells, but also of the cells themselves. The use to which he has put them, however, has led to many absolutely new experiments, so far as I know. It is also a point of interest to know, as probably some of you do know, that Plante himself tried a method, many years ago, of covering the plates with minium. If Prof. Barker were here, he would bear witness to the fact that Plante has used both; that he tried the same thing several years ago, and found that it was not so effective as a battery of his own plates by the method adopted, which, though necessarily slow, probably resulted in a better form of cell. So it is gratifying to know, from the experiments of Prof. Preece, that we are advancing, so far as new experiments are concerned, and that we are finally going back to the original form devised by Plante.

There may be one reason worth mentioning. We are all well aware of the careful and interesting experiments referred to by Mr. Bright, on the chemistry of the secondary battery. These experiments show us that there is a greater or less formation of the lead sulphate in connection with the cell adopted; and that also shows us why the electromotive force, having run down, after a period of rest, is recovered to a certain extent. A great many points have been cleared up that were certainly quite enigmatical before. Now, some experiments, and I think some of those that have been published by Prof. Barker, go to show that, in the Plante cell, as formed by Plante—by a rather slow and tedious process, but by the method of Plante—there is at least a small amount of lead sulphate produced. I take it that the giving-out of the cell is due to the formation of sulphate; so that, if these cells are formed by the rules laid down by Plante, they will have a tolerably long life. Now, just one word with regard to the cost. You will remember that a year or so ago Prof. Langley showed, I think beyond any question, that the percentage of the radiant energy from an Argand gas-burner that is effective in producing illumination is less than one per cent. It certainly is a very curious result. It is less than one per cent., and there is little doubt about the energy which goes up through the chimney.

Ignition of Flour Dust by Electric Lights.

A short reference was recently made to the above subject in *The Milling World*. As the matter of lighting mills by electricity is receiving more and more attention, the following particulars of the experiments made in Germany, as given by the *Spectator*, may be of interest to our readers:

Herr Bohler, illumination inspector of Dresden, has been making some experiments to determine what part is played by electricity in causing explosions of flour dust in mills. His investigations have been conducted at the Royal Court Theatre, where the powerful dynamos for the electric lights are driven by steam power. "Here," the inspector says, "the electricity from the belting is so intense that more could scarcely be obtained in the best electrical machines. Leyden jars became charged by this means in a few seconds, so that on being discharged sparks leap one and three-fifths inches. Any person standing on an insulator, and placing the hand within four to six inches of the moving belts, is quickly charged with electricity, so as to give out long sparks. Geissler tubes, having projecting pointed wire at one end, and metallic connection with the earth at the other end, glowed, when placed near the belts, with beautifully colored lights. In short, every experiment possible with electric machines can be performed by this belt-developed electricity. At first I thought that the presence of the dynamo-electric machines had a great influence on this phenomenon, but I have noticed the same, more or less shown, in many kinds of factories having steam power.

"In many flour and meal mills the dust has become ignited without the cause having been discovered. I have now, from experiments, become firmly convinced that electricity developed by belts can cause such disaster. In most factories, other than flour mills, the quantity of metal present, and the arrangement of the iron-framed machines, is such that a connection among them is established sufficient to conduct safely away the electricity. It is, however, different in flour mills, especially where French burr stones are used, which are made of separate pieces bound together by thick iron bands. The latter are not connected with another, but isolated by the non-conducting stone. Rims, therefore, which are next to the driving pulleys and belts (generally located just below stones when cog-wheels are not used, and pulleys almost equal in diameter to the stones) become surcharged with positive electricity—as shown in the Leyden jar, for instance—the next nearest rim or rims will, by induction, develop negative electricity. These opposite forms of force having arrived at a dangerous degree of tension, the leaping of an intense spark from one stone band to another could ignite the excessively inflammable flour dust. To guard against this danger, it is simply needful to collect the iron spindles of the stones together by a thick wire, a metallic bar being at the same time located nearly touching both stone rim and driving pulley. In all other industrial works the precaution would be advisable that no isolated ironwork should be near pulleys and belting when combustible materials are also in the immediate neighborhood."

—— The Brush Electric Light Company, of Buffalo, has recently secured contract with city for 325 electric lights at $200.75 per light per year, or 55 cents per light per night. They have added three more 11x11 Westinghouse automatic high-speed engines, making eleven now in the station.

ELECTRIC LIGHT NEWS

—— The Brush Electric Light Company at Detroit employ the Tower system, as follows: They have six loops of lines radiating from the manufactory, and taking in the entire city. These loops average ten miles in length—sixty miles of wire in all. On five of these loups there are fourteen towers, and on the other, ten—eighty towers. Each loup is supplied with electricity by a 65 light dynamo, but there are but fifty-eight lamps, on an average, in each circuit. The result is that they are giving the city a light of from 2,200 to 2,500 candle-power, instead of 2,000, as they had agreed to furnish. The engine that runs the five big dynamos is of 420 horse-power, but is being run up to only 250 horse-power. The other two engines, working the smaller dynamos, are each of 300 horse-power. Each of the five boilers can provide 200 horse-power, so that they have a capacity of fully 1,000 horse-power, while doing but 570 or 580.

—— George C. Pyle, a young inventor of Dayton, has perfected a headlight that has thus far proved highly successful. The invention has been purchased and will be manufactured by a company that has been formed in Akron, under the name of the American Electric Headlight Company, with Lewis Miller for its president; W. B. Raymond, treasurer, and Leonard Moore, secretary. An excursion train was run from Akron to Cleveland and return last night under their auspices, and conducted by C. F. Stewart, and accompanied by several members of the company. The excursion train left Akron at 6.40. The run to Hudson was made with a short stop at Cuyahoga Falls. The engineer of a C. and P., which stood on the track at Hudson, said he saw the reflection of the light twenty minutes before the train stopped at the station. The persons most interested in the light were given an opportunity to witness its effects from the cab of the engine, changes being made when the engine stopped, to accommodate as many as possible. The light streamed full and clear, far ahead of the engine, illuminating the track to fully half a mile in advance. So powerful was it that young birds were disturbed from their roosting places, and, after fluttering in front of the light for a moment, were lost in the darkness as the swiftly-moving train shot by. It seemed that the boast of the Yankee to an English engineer that the headlights were so strong on American engines that the chickens were lured from their roosts, believing day had dawned, was about to be fulfilled. Just before the train drew into Bedford one of the carbons broke, owing to a defect in its composition—the first instance that has occurred, during a test of six months, in which the light has been carried over more than 35,000 miles. A new carbon was immediately substituted, and in less than a minute after the train stopped the light again shone as brilliantly as before. The dynamo that furnishes the light is a small affair fastened to the footboard of the engine on the left side, and directly in front of the cab. It is run by a three horse-power rotary engine, fastened between it and the cab, the steam power being derived from the boiler of the engine. The light is equivalent to that which would be derived from 2,000 candles. The power necessary to run the dynamo will not exceed one and one-half horse-power. The mechanism of the lamp is kept a secret by the company, which has already possession of twelve patents covering its various parts, and expects to secure still others. It is so constructed that it will burn in any position, as long as a current passes through it and the carbons hold out The same lamp was tested during the months of February and March over the Panhandle road, then over the Richmond and Danville road, and later over the New York, Pennsylvania and Ohio between Galion and Dayton.

ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING OCTOBER 21, 1884.

306,718 Insulator; Edward Clark, Jersey City, N. J.
306,719 Insulator; Edward Clark, Jersey City, N. J.
306,764 Multiple electric arc lamp; Richard H. Mather, Windsor, Conn.
306,789 Electric Switch; Henry E. Waite and Samuel H. Bartlett, New York, N. Y., assignors to Charles F. Livermore, trustee, same place.
306,805 Electric motor; John B. Atwater, Chicago, Ill., assignor by direct and mesne assignments of part to Joseph B. Long and Abram M. Pence, both of same place.
306,817 Telephone exchange appliance; Jabez Fearey, Newark, N. J.
306,818 Trunk table for telephone exchanges; Jabez Fearey, Newark, N. J.
306,845 Multiplex electric arc lamp; Richard H. Mather, Windsor, Conn.
306,932 Circuit-controlling instrument; Fred Lane, Boston, Mass.
306,957 Electric meter; James F. Ray, Detroit, Mich.
306,977 Telegraphy; Peter H. Vander Weyde, Brooklyn, N. Y.
306,998 Air-tight electric arc lamp; William Baxter, jr., Jersey City, N. J.
307,025 Electric wire supporter; Oscar M. Draper, North Attleborough, Mass., assignor by mesne assignments to himself and Albert Scranton Weaver and Oscar N. Bender, both of Providence, R. I.
307,026 Telephone transmitter; Daniel Drawbaugh, Eberly's Mills, Pa., assignor to the People's Tele-phone Company, of New York.
307,029 Filament for incandescent lamps; Thos. A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Company, New York, N. Y.
307,030 Electrical meter; Thos. A. Edison, Menlo Park, N. J.
307,031 Electrical indicator; Thomas A. Edison, Menlo Park, N. J.
307,062 Electric arc lamp; Francis M. Newton, Belfast, county of Antrim, Ireland.
307,064 Automatic machine governed by electricity for controlling elevators; Charles E. Ongley and Emery W. Sturtevant, Worcester, Mass., said Sturtevant assignor to said Ongley.
307,070 Electric gun; Samuel Russell, Brooklyn, assignor to the American Electric Arms and Ammunition Company, New York, N. Y.
307,071 Electric cartridge; Samuel Russell, Brooklyn, assignors to the American Electric Arms and Ammunition Company, New York, N. Y.

RE-ISSUES.

10,533 Electric bell; Edgar W. Hazazer, New York, N. Y.

A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.

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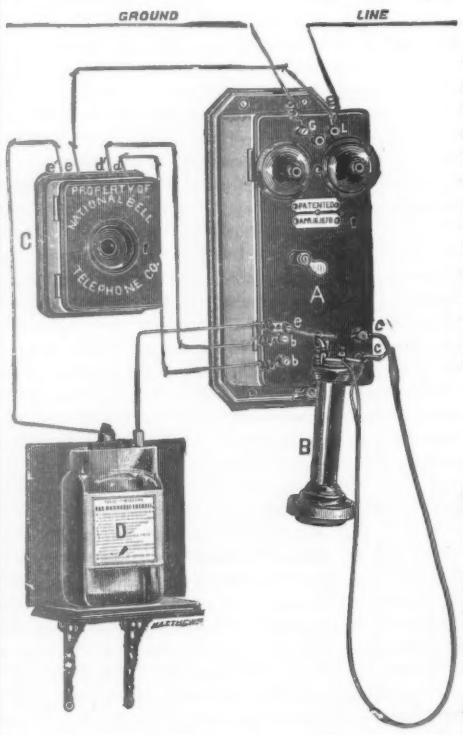

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